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THE PANAMA CANAL.

REPORT

OF THE

HON. JOHN BIGELOW,

DELEGATED BY THE

Chamber of Commerce of New-York

TO ASSIST AT THE

INSPECTION OF THE PANAMA CANAL,

IN FEBRUARY, 1886.

STANFORD LIBRARY

SECOND EDITION.

NEW-YORK:
PRESS OF THE CHAMBER OF COMMERCE.
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At the meeting of the Chamber of Commerce, held February 4, 1886, Mr. Cornelius N. Bliss, Chairman of the Executive Committee, submitted the following communication received from Mr. Ferdinand de Lesseps, President of the Universal Interoceanic Panama Canal Company, inviting the Chamber to appoint a delegate to accompany him on his visit to Panama to inspect the Maritime Canal:

Paris, *January* 11, 1886.

Mr. President:

I propose starting on the 28th January by a steamer of the Royal Mail Steam Packet Company to go and inaugurate at Panama the period of final execution of the Maritime Canal.

All the Isthmus, from one ocean to the other, is now in the hands of twenty-seven contractors, each having agreed to execute his task within the time mentioned.

It is important, to a very high degree, that no doubt should exist any longer upon the completion of the Panama Maritime Canal, so that, at the time of its inauguration, ship-owners and merchants may be ready to utilize it, and that nothing should happen, as it did on the eve of the inauguration of the Suez Canal, that the completion of the work should surprise the universal navy invited to pass through the interoceanic Bosphorus.

It is for such a purpose, Mr. President, that I ask you to please propose to the Chamber of Commerce of New-York to appoint a delegate to accompany me on my visit.

I have also addressed a request to the Chambers of Commerce of France; and I have, besides, the satisfaction to inform you that delegates from England and Germany will join the representatives of our French Chambers on this occasion. The Universal Interoceanic Panama Canal Company will, naturally, defray the expenses of the trip, which, from the start to the return, will last about two months.

Please accept, Mr. President, the assurance of my distinguished consideration.

(Signed,) Ferd. de Lesseps.

To the President of the Chamber of Commerce, New-York.

On recommendation of the Executive Committee, the invitation was unanimously accepted, and the Hon. John Bigelow was appointed a delegate to represent the Chamber on the occasion.

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E. L. Plunkett

LETTER OF Mr. BIGELOW.

21 Gramercy Park,
New-York, *April* 15, 1886.

Mr. James M. Brown,
President of the New-York Chamber of Commerce:

Sir: In compliance with your request, I joined Mr. de Lesseps and his companions at Colon on the 18th of February last. The party congregated there for the inspection of the Panama Canal consisted, beside myself, of

Ferdinand de Lesseps, *President of the P. C. Company.*
Charles de Lesseps, *Vice-Pres't* " " "
Theodore Motet, *Ex-Capt. of Artillery, Administrator of the P. C. Company.*
Etienne Martin, *Sec'y General of the Company.*
Bunau-Varilla, *Engineer and late Provisional Director General.*
Forestier, *Chief of Transportation and Maritime Operations of the Canal Co.*
The Abbé Tiberi, *Chaplain of the Hospital at Colon.*
Saleta, *Naval Lieutenant, Agent of the Company at N. Y.*
Villars, *Counsellor of the Municipality of Paris,*
Bonnafous, *Engineer in Chief of Roads and Bridges,*
D'Nicolas, *formerly Surgeon in the Navy,*
Associates in the contract for the works at Emperador and of the dam at Gamboa.
Henri Cotter, *Stockholders' representative on the Committee for verifying accounts.*
The Duke of Sutherland.
Nathan Appleton.
Leon Peschek, *Engineer attached to the German Embassy at Paris.*
The Marquis of Teano, *of Italy.*

Roux, *Delegate from the Chamber of Commerce of Marseilles.*
Ferry, " " " " " *Rouen.*
Meresse, " " " " " *St. Nazaire.*
Bichon, " " " " " *Bordeaux.*
De Molinari, *Editor of the Paris "Economiste."*
Tissandier, *Aeronaut and Editor of La Nature.*
Stanhope, *Journalist, representing the N. Y. Herald.*

Every practical arrangement for the accommodation of our party and for the most profitable disposition of our time while sojourning on the Isthmus had been made by Mr. Charles de Lesseps, who had gone out to the Isthmus a few weeks before us. Nor were any efforts spared apparently to secure to us every facility for inspecting the work, as well what remained to be done as what had been done, within the time we were expected to devote to it. The railroad lies parallel with and only about half a mile distant from the line of the canal for nearly its entire length, and as the journey from one end to the other by rail may be made in less than three hours, the difficulties of inspecting the line were less serious than I had anticipated. The boats of the Company in the harbor at Colon and at Panama, also, were always at our disposal.

Of course it did not enter into our scheme to revise the surveys or to verify the quantities and dimensions which were involved in the enterprise, and, so far as I shall venture to cite any, they will be the most trustworthy that I have been able to glean from the various sources of information to which we had access, and which were often conflicting and rarely more than approximative.

The project we were invited to inspect contemplates the connection of the waters of the Atlantic at Colon with the waters of the Pacific at Panama, by a canal of a uniform level, without locks or tunnels, and broad enough and deep enough for the transit of ships of the first class from the open sea at either end, to the open sea at the other, without any necessary interruption or detention. A uniform level and an open cut, without tunnels or locks, were, in the eyes of Mr. de Lesseps, of paramount importance in a country exposed, as all the States of Central America are, to more or less frequent earthquakes. He had given the preference to this over all the other interoceanic routes that have been projected, because he believed it to be the only one that would satisfy all those conditions.

The total length of the canal is to be about 46½ miles, or 75 kilometres. The flow of the canal is to be, through the valley of the Chagres of the same width at bottom as the Suez Canal, 72 feet. In the section between San Pablo and Pedro Miguel it is to have 78 feet at bottom and 102 feet at water level. Through the Cordilleras at Culebra the width at the bottom will be 72 feet, and 100 feet at water level. The depth of navigable water in the canal is to be from 28 to 29 feet, and the curves are to have a radius of not less than 8,000 feet.

The plan involves, also, the construction of a basin 1,600 yards long and 110 yards wide at Panama for the accommodation, not only of vessels passing through the canal, but for those which are loading and unloading there, and another large basin or siding about three miles long at Tavernilla, a point about half way between Panama and Colon, for a turn-out, or place for ships to cross each other in transit.

Such, in general, are the accommodations which it is proposed by Mr. DE LESSEPS and his associates to provide. Commencing with the sea level at Colon, the land along the line of the canal for the first ten miles reaches gradually an elevation of 20 feet at Dos Hermanos; the next seven miles, to Frijole, it attains an average elevation of 40 feet, except at Bohio Soldado, where, for a short distance, it encounters a hill about 170 feet high. From Frijole to Mamei, about seven miles, the elevation to be overcome ranges from 50 to 120 feet. From Mamei to Matachin, about three miles, the canal has to pass through a hill 170 feet above tide water. From Matachin to Culebra, seven miles, the canal encounters a series of hills varying from 100 to 250 feet high, and at Culebra, the highest point on the line, the elevation is about 322 feet above the bottom of the canal, though this height is maintained for a few hundred yards only. From Culebra, the land falls away again on the Pacific side to an elevation of only 30 feet at Rio Grande, three miles from Culebra. From Rio Grande to La Boca, five miles, the line falls away again rapidly to the level of the ocean. To attain a proper depth of water, the canal must be dredged about four miles further into the Bay of Panama towards the Island of Perico.

The total excavation necessary to give the required width and depth to the proposed canal, as estimated by the engineers, amounts, in round numbers, to 120,000,000 cubic metres.

The total excavation made up to December 31, 1885, was, by contract, 11,490,196 cubic metres; by the Company, 1,520,837; a total of 13,011,033 cubic metres; excavation during the month of January, 1886, 1,067,823 cubic metres; total, 14,078,856 cubic metres; leaving to be excavated 105,921,144 cubic metres.

Should the excavation, through the remaining months of the year, average as high as for January, 1,067,823 cubic metres, it would make the cut for 1886 amount to 12,813,876 cubic metres, and the total of excavation, up to the close of the current year 1886, 25,824,909 cubic metres, leaving to be excavated, in round numbers, 94,175,000 cubic metres, or less than four-fifths of the whole.

Of the total excavation, about one-third may be executed by dredges, which can work all the year round. The other two-thirds will be dry excavation of earth and rock, much of which cannot be handled by machines or otherwise to advantage during the rainy season. To keep up through the year to the average of the out-put in January, it will be necessary to somewhat increase the number of dredges or excavators, or both, for which I understand that arrangements are made.

On the 31st of January, 1886, there were reported to be about fifteen thousand men employed upon the canal—twelve thousand by contractors, two thousand of these ineffective, and three thousand by the Company; in all, less than three hundred effective men per mile. There are reported to be twenty-one dredges and eighty-two excavators at various points on the work, with the requisite auxiliary boats, trains and machinery.

With, say 119,000,000 cubic yards of excavation to make, of which one-third may be done by dredging, the problem presented would seem to be a very simple one.

If with 15,000 men, 21 dredges and 82 excavators, a cube of say 16,658,028 of yards can be extracted in a year at the mean rate of 1,388,169 cubic yards per month; by doubling this force the out-put for the year 1887 would be at the least 33,000,000 cubic yards, which would complete the work by the end of the year 1890; and if the present force of men and machinery were trebled, the annual out-put would be at the least 49,000,000 of cubic yards, and the excavation of the canal would be accomplished in 1889.

Given the daily cost or wages of men, dredges and excavators, it would seem as if a school boy might determine to a fraction the time when the canal will be finished and what it will cost.

Nothing could be more illusory.

There probably was never a more complicated problem—a problem embarrassed by a larger proportion of uncertain factors—presented to an engineer. All the conditions under which this work is to be conducted are peculiar and exceptional.

It is in a foreign State; under a weak and unsettled government; in one of the most unhealthy regions on the continent; subject to earthquakes; within 450 miles of the equator, and under a tropical sun where acclimated laborers only are of any service. Everything required for the prosecution of the work—utensils; machinery; the plant for constructing and repairing machinery; for the most part the provisions and houses for the sustenance and shelter of the men, and even the men themselves—have to be imported from foreign countries. The country practically contributes nothing but the site for the canal.

This work, which, for its inevitable cost, and, if accomplished, for the magnitude of its material results, has no parallel among private enterprises in all history, is attended by so many uncertain and unknowable conditions that the estimates of the most gifted and experienced engineers are at the best but conjectures. Every step that is taken, therefore, is more or less experimental, and defies any attempt at reduction to a scientific equation.

The most serious difficulties with which the Company has to contend may be classified under four heads:

First. The control of the waters of the Chagres River, which, in the rainy season, if unrestrained, is liable to flood the larger portion of the canal every year.

Second. The cut through the Andes at Culebra.

Third. Keeping that section of the canal which runs from La Boca towards the Island of Perico in Panama Bay from being filled in by the ocean and the Rio Grande.

Fourth. Securing the amount of labor required at practicable rates.

THE WATERS OF THE CHAGRES RIVER.

This river, which, in the dry season, with its three or four tributaries, has a normal flow of only between 450 and 500 cubic feet per second, discharges from 23,000 to 25,000 cubic feet at times in the wet season, and has been known within recent years to discharge between 68,000 and 69,000 cubic feet per second, and to rise from 40 to 50 feet above its normal level.

Of course, no canal with such a neighbor at large, could live through a single rainy season. Two plans for its subjugation have been discussed, one to construct a dam across the head waters of the Chagres at Gamboa and before they enter the valley through which the canal is to pass, large enough and strong enough to hold all the water that may fall, over and above what can be carried away safely by the ordinary channel of the river, which is to be straightened at several points for the double purpose of increasing the discharging capacity of the channel, and also to avoid the intersection of the natural by the artificial waterways.

Auxiliary to this work, derivative canals or water courses are to be cut, to separate from the canal the waters of the Chagres and its tributaries, and carry them directly to the sea.

Another plan which has been discussed and is now under consideration, is to dispense with the dam altogether, and to enlarge the derivative channels sufficiently to carry off the greatest volume of water by which the Chagres is liable to be swollen.

This would involve a very considerable increase in the width of the derivative channels. Whether it will cost more or less than the dam is a question which I understand M. BOYER, the new Director-General, is investigating. Till that question is settled, the work on the dam will not be started. At present, however, the presumptions are all in favor of the dam, and the work now in progress on the derivative channels is prosecuted on that theory.

Nature, too, seems to have favored this solution of the Chagres difficulty. After passing Matachin the Chagres River turns sharply eastward in its course, leaving the line of the canal between the 44th and 45th kilometres, and passing between two hills or Cerros, about a mile distant from the canal at Gamboa, called the Cerro Obispo and the Cerro Santa Cruz.

It is between these two hills that it is proposed to erect a dam about three-quarters of a mile long, 140 feet high, and about 1,300 feet wide at the base, with an exterior slope of four to one, of broken rock, to be brought from the Emperador and other most convenient cuts; this to be revetted with heavy rock. On the basin side clayey earth is to be dumped and allowed to take its natural slope, on a presumption that the pressure of the water upon the clay, aided by deposits brought down by the river, will gradually make it water-tight. From the basin thus formed an outlet is to be provided by cutting a tunnel through the Cerro Azul to the left of the Cerro Santa Cruz, which is to have a diameter of about twenty feet, and to be lined with iron, through which the waters in the basin are to be discharged in quantities which the Chagres can carry to the sea without overflowing its banks. The tunnel will be prolonged by a cut to the bend of the Chagres at about kilometre 44. Its length from the basin side of Cerro Azul to the river will be between 500 and 600 yards, with a fall of about 30 feet. The inner orifice of the tunnel will lie between the 25th metre and the 31st metre levels. Complete surveys have not yet been made, but levels and contours had been run, we were assured, to exhibit a basin capacity of 3,000,000,000 cubic metres, with an indefinite capacity beyond the line surveyed.

With these data it has been calculated that it would require eight or nine days of exceptionally heavy and continuous floods to fill 40 per cent. of the basin space ; that the outflow through the tunnel would be about 26 per cent. of the amount retained, and leave the surface of the water at least 30 feet below the top of the dam. An inflow of 1,600 cubic metres a second, which is the discharge of the Chagres at Gamboa at extreme high water, as determined by Colonel TOTTEN in 1857, is taken as a basis of these calculations, being the largest inflow yet recorded.

The discharge at Gamboa during the extreme high water of the 25th of November last was 954 cubic metres a second—a figure not likely to be often reached, and never much, if at all, exceeded. Such are the plans and calculations of the Company's engineers.

To construct this enormous dam it is estimated that about 9,000,000 of cubic yards of earth and stone will be required. The cuttings at Emperador and the neighborhood will furnish an abundance of both. That such a dam, if built with the capacity attributed to it, will hold all the water that can be accumulated at Gamboa at any season, there can be little doubt. The floods at Matachin are of short duration, resulting from rapid local rainfall, not from an extensive water shed. The water shed, on the contrary, is comparatively inconsiderable, and if the rain did not fall there more rapidly than it usually falls in the State of New-York, the freshets of the Chagres would probably be less formidable than those of the Hudson. They result from the rapidity rather than the quantity of the rainfall. By the artificial tunnel which it is proposed to provide, the water will be allowed to enter the lower bed of the Chagres only so fast as it can be carried off without overflowing the river's banks, and, therefore, will remain in the basin and a pressure on the dam only so long as it will take to run off through the tunnel at the rate of between 12,000 and 15,000 cubic feet of water per second, when nòt re-inforced by rain.

I did not hear any doubts expressed in any quarter of the practicability of building such a dam as an engineering problem, nor is there any greater difficulty, theoretically, in building a dam a mile long and ten rods high than in building one a rod long and one foot high. The difference is rather a question of cost than of practicability.

It seems to be assumed by all the eminent engineers who have studied this question, that such a dam, if built with the proportional derivations and embankments, would give the canal ample control of its turbulent neighbor at all seasons. I am aware of no reason for questioning the soundness of their judgment.

THE CULEBRA CUT.

At about the 15th kilometre from Panama, and 55th from Colon, canal encounters the Cordilleras chain of mountains, and one of the most formidable obstacles which a sea level canal here, presents to an engineer. To cut this hill down to nine metres below the level of the ocean at low water, involves the removal of a body of earth and rock amounting in the aggregate to some 22,000,000 of cubic yards. This enormous body lies within a span of only about two kilometres, or less than a mile and a half. The necessity of discharging the excavated material exclusively at the ends of the cut when the men get below the surface of the canal must reduce the product of a day's labor.*

The contract for this work was taken some years ago by an Anglo-Dutch Company, who bound themselves to remove 700,000 metres a month. This contract was subsequently modified so as to require the removal of only 610,000 monthly for the eighteen months following January 1st, 1886, making 11,000,000 cubic metres, and 330,000 a month for the succeeding twenty-four months, to July 1st, 1889, making 8,000,000, which amounts added to the amount removed before January 1, 1886, say 1,000,000, would give the required result—20,000,000 cubic metres. For this the contractors were to receive eight francs the cubic metre, or 32,000,000 of dollars, the Canal Company engaging to furnish them, as to the other contractors, their machines and the men, the contractors only paying the men's wages, and a certain rent for the use of the machines. Of course, any failure to supply men enough or machines enough, leaves the contractors at liberty to abandon the contract whenever it ceases to be profitable. The results are such as might be expected. Though bound to remove monthly 610,000 metres, they have not yet, I am assured, been successful in getting away in any one month with 100,000 cubic metres. Should they not increase that average, it will take from ten to fifteen years to finish their contract, even should they suffer no unforeseen delays or interruptions. Doubtless means will be found to expedite this work, which, in its present stage, could be readily effected by an increase of men and machines. The last 30 metres of the cut, however, must necessarily prove tedious and costly. Apprehensions have been expressed that during the later stages of the work at this point the banks might wash or slide, and fill up the cutting, as well as endanger the lives of the workmen. That, however, could only result from bad engineering. Perhaps those who give most importance to this criticism do not properly estimate the rapidity with which vegetation would cover the slopes, and bind them so compactly that in a few months a yoke of oxen would hardly be able to haul a plow through them.

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* It is hoped that inclined planes may be successfully employed to expedite, if not to cheapen the process of disposing of the waste material; and a number of these contrivances, I am told, are now on their way to Panama, I presume, for that use.

I did not hear of any insuperable difficulty in the accomplishment of this work, but I cannot but think that Mr. DE LESSEPS will be disappointed in his calculations, both in regard to the time and the cost of it. It certainly is not progressing at present at a rate which warrants the hope of its completion in 1889.

THE PANAMA SECTION.

But little work has been done at the easterly extremity of the canal in the way of excavation, and none was in progress when we visited it. A channel about sixty yards wide has been dug to sixteen feet below mean low water, from the end of the proposed canal, a distance of three miles, and a little cutting has been done at the mouth of the Rio Grande, but no excavation has been made in the Panama section inside of the shore line.

The difficulties which beset the work on this section may prove to be, to some extent, imaginary, but they seemed to me quite serious. The disposal of the dumps is tedious and expensive; a dyke will probably have to be run from Gama Point nearly to Naos Island, some four miles, to keep the sand from washing into the canal, and a temporary dam to keep the water high enough to float the dredges, at low tide, must be built across the Rio Grande. All the works for the construction of dredges and other machinery were erected at La Boca, that is, at the mouth of the Rio Grande, and constantly exposed to the pestilential exhalations of the mangrove swamps through which that stream finds its way to the sea, and through the bed of which the canal is expected to flow. To keep up the force requisite for the mechanical operations to be carried on at this point will prove extremely difficult, on account of its insalubrity. Owing to the impracticability of bringing dredges around Cape Horn or across the Isthmus, it has been deemed necessary to provide a plant for the construction and repair of such, with their accessories, as may be required on the west side of the mountain. For this kind of work, but few of the acclimated operatives are available, and to expert machinists the climate is very unfriendly. Plans are in contemplation—the dam across the Rio Grande is one of them—which, by overflowing the marshes, it is supposed, may improve the sanitary condition of La Boca. Should they altogether fail, it is not easy to calculate the time when the work on the canal west of Culebra will be finished, notwithstanding the fact that human life is about the cheapest article to be purchased on the Isthmus.

Aside from the three places of work I have just indicated, the damming of the Chagres, the cut at Culebra and the Panama section, I am aware of no good reason for doubting the ability of the contractors to finish the rest of the canal by 1889. It is all under contract, and the work is going on at different points along the line.*

THE LABOR SUPPLY.

This is a question which presents more elements of uncertainty than any other which I have encountered in my hasty study of this subject, and I am persuaded that just in the proportion that that

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* The following list of contractors, and the cost of the work expected of them, were furnished me by an officer of the Company:

Names of Contractors.	*Cost of their Work.*
American Contracting and Dredging Company, (dredging,) (from Colon to Kil. 23,)........fcs.	22,500,000
Barbaud, Vignaud & Blanteuil, (from Kil. 23 to Kil. 44,).....	70,000,000
Société de Travaux Publiques et Construction Company,) from Kil. 44 to Kil. 55,)........	280,000,000
Cutbill, de Lungo, Watson & Van Hutton, (Culebra,).........	160,000,000
Franco-American Dredging Company, (dredging,)........	9,000,000
Letellier, Lillaz & Barafous, (from Culebra to the Pacific,)...	80,000,000
fcs.	621,500,000

question shall prove to be or not to be susceptible of satisfactory solution, will the other difficulties lose or gain importance. It is, as it seems to me, the axis on which the fortunes of this enterprise revolve.

The canal terminates at both ends in a mangrove swamp, while the river bottoms through which the canal is to pass are, all the way, more or less swampy. For seven months of every year it is liable to rain not only every day but several times a day, and when it does rain at this season, the water does not come down, as with us, in drops, but in sheets, so that to be out of doors when it rains means, being as completely wetted as if thrown into the sea, and it means a suspension of work for at least two-thirds of the seven rainy months.

To get cool from the effects of such a shower so that the normal perspiration is checked, means for a northern man, in nine cases out of ten, a fever in a few minutes and a funeral in a few hours. To this add the pestilential atmosphere engendered by a tropical sun falling upon the vast surface of vegetable matter continually moistened by rain, and you have a climate where it may, without exaggeration, be said that—

> "Life dies and death lives."

The native races of the tropics, here mostly of African origin, seem to be the only human beings constituted to endure hard labor while exposed to the Isthmus sun. But of this labor the supply in the State of Panama is very inconsiderable, the whole population, including the importations of the Company, being less than 150,000. The labor, therefore, for the most part, has to be imported. Most of it, thus far, has come from Carthagena, Jamaica and the lower valley of the Mississippi. This supply is limited. The climate has taught the laboring class in these latitudes to avoid the continuous hard labor which can be safely endured in the temperate zones ; and, as an indemnification, requires of them no provision against a long, cold winter, and provides them with a fruit bearing vegetation all the year round, which always ensures them against the pangs of hunger—one of the inexorable penalties of idleness with northern operatives.

Their wants are but little more difficult to satisfy than those of the birds of the air or of the beasts of the field. They have no tastes to gratify by accumulation ; and if they had, they have no place in which they could put their accumulations in security except, like the dogs, they bury them in the ground. If, therefore, they earn more than they consume, the only way they can keep the surplus is to convert it into pleasure of some kind as soon as possible, and pleasure with them usually means idleness and gambling It is impossible to stimulate such a race in such a climate by the inducements which are so efficient in securing thrifty operatives in higher latitudes.

When the work on the canal was begun, the wages of unskilled labor were 90 cents a day. The supply at that rate proving insufficient for the needs of the Company, they were advanced from time to time until now they have reached a minimum of $1.75.* And though the price of labor is nearly doubled, there are not 15,000 effective men, all told, now on the work.

Agents of the Company are constantly employed in recruiting men in all the available markets, to whom liberal commissions must be paid. The men are brought there at the expense of the Company, but many of them leave again—some because they do not like to work hard every day; some because they are frightened by the mortality around them; some because they cannot get on peaceably with the men they are working with; some because they wish to enjoy the money they have already earned; while some are dismissed because they are good for nothing, or foster disaffection among their comrades. For these and other reasons which can readily be imagined by those who are familiar with the caprices of the untutored African, the Company, which is bound to the contractors to supply them with all the men they require, have not been able to keep up their quota, and, as a consequence, cannot, if they would, enforce the forfeit to which each contractor has bound himself in case of the non-fulfilment of his contract; while the contractor, on the other hand, if not supplied with his quota of men, is at liberty to throw up his contract whenever it shall cease to be remunerative. This, I presume, is the explanation of rumors which were in circulation at Colon of contractors leaving the rock which they encountered in their section, and upon which work was unprofitable or less profitable, and passing on to the earth work, which was more profitable.

These are among the inevitable conditions of such a work on the Isthmus. No one could prudently take a contract there unless the Company would engage to supply the labor, for, with the other contractors competing for it in a scanty market, labor would soon be at such a premium as to ruin them all.

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* The wages of skilled black labor are $2.50 to $2.75 *per diem;* white mechanics, $5 gold.

Of course, with 12,000 effective men,* or with twice that number worked under such conditions, I do not see how any one can cherish the expectation of completing the canal in 1889.

The question then arises, must the work be prosecuted under the present conditions?

"When the Jews were required to make brick without straw, Moses came." May not the exigency, like child bearing, work its own cure?

In all ages and nations when manual labor has become too costly to do the work for which there was a universal or even a general need, a substitute for it has been promptly devised. It was to the need of economizing muscular labor that we owe the hoe, the wheelbarrow and the plough. Had laborers' wages never arisen above a shilling a day, we should never have heard of McCORMICK's reaper, or of HOWE's and SINGER's sewing machines. It is equally certain that the portion of our planet which lies under the tropics will never play the part in human history to which its territorial extent and productive power entitles it, until our present assortment of mechanical substitutes for muscular power has been very largely increased. Machines do not mind malaria; they are not poisoned by marshy water; they thrive on the black vomit; they have no fear of chills or sunstrokes, and what is more, they are never tired, and will work all the days and nights of their natural lives without interruption, if properly fed and cared for.

That is the class of operatives for out of door work in the tropics, and it is to them that Mr. DE LESSEPS must, and I presume does look for an early completion of his canal, for it is in that direction his own remarkable experience has certainly taught him to look with some confidence. When the work on the Suez Canal was begun, and under climactic conditions much the same as those at the Isthmus of Panama, the Suez Canal Company was entitled by its charter to as many native laborers as it required up to 40,000, and at an almost nominal price. As these men were drafted into the Company service by *Corvée*, England protested against a "revival of slavery" in Egypt. The Khedive was constrained to break his contract with the Company, for which he had afterwards to pay an indemnity of 38,000,000 francs, and M. DE LESSEPS had the mortification of seeing his little army of 20,000 fellahs dispersed as suddenly and as irrevocably as an April fog, leaving only their tents and tools behind them.

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* This is the number on the rolls, but a suspicion seemed to prevail on the Isthmus that even this number is considerably exaggerated.

The logic of the situation promptly suggested the replacing of the men with machines; the putting of slaves without souls or sensibilities in the place of slaves with both. The inventive genius of his countrymen was stimulated by the gravity of the crisis, and in due time from eighty to one hundred dredges, with an appropriate supply of barges, elevators, steam tugs, locomotives, &c., had taken the place of a large portion of the men withdrawn; and this machinery, with only 4,000 men, increased the monthly out-put from 10,000 cubic metres to 2,000,000, and executed more excavation in the last three years of the work than had been done in the previous seven. May not the scarcity and cost of manual labor on the Isthmus in like manner develop the means of dispensing with at least that portion which the labor market will not cheerfully supply?

The results already accomplished in that direction justify the expectation that, to a considerable extent, it may. There are already at work on the Isthmus machines for dredging and for excavation far more powerful and efficient than any ever used on the Suez Canal or any where else. The Slaven Brothers, representing "The American Contracting and Dredging Company," of New-York City, have a contract for the excavation of some 30,000,000 cubic metres in the main canal, in the derivatives of the Chagres, and in the harbor of Colon. They have seven dredges in operation. I saw one of them, the "New-York." It was excavating at the average rate of 6,500 cubic yards every twenty-four hours. It is equipped with thirty-six buckets, made of steel, each weighing, with its links and pins, 2,500 lbs. when empty, with a capacity of one cubic yard each, or an ordinary one horse cart load. These buckets are run at a speed of from sixteen to twenty-four buckets full per minute. The contents of these buckets, as fast as they revolve, are literally blown through pipes 170 feet long, one on each side, over on to the banks beyond the canal, with a velocity of from 500 to 1,000 feet per minute. The work with which these seven dredges were credited for the month of January last amounted to 728,000 cubic metres. That is, I believe, about double the largest out-put ever accomplished by any machine on the Suez Canal, and considerably in excess of the out-put of any machine elsewhere.*

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* The following statement of the work accomplished already and expected

One or two of the excavators are equally exceptional as to power and efficiency, nor is there any reason to suppose that, in the

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from the American dredges was furnished me by an officer of the American Company, and illustrates the view I have endeavored to present:

Memorandum of the Work done by the American Contracting and Dredging Company on the Panama Canal.—The American Contracting and Dredging Company have a contract for the excavation of 30,000,000 of cubic metres of dredgible ground, in the main canal, the basin or artificial port of Colon, and the auxiliary canals for the derivation of the Chagres River.

This work extends from Colon to Matachin, a distance of about 44 kilometres of main canal, with probably 30 kilometres of auxiliary canal, besides the work in the port of Colon. The height of the ground to be excavated varies from one metre to eight metres above mean water level, but even a bank of this last height (26 feet) is attacked with great facility by the large dredges with two discharge pipes.

In one of these high banks the dredge "City of New-York" is now working very effectively, excavating an average of 6,000 cubic metres per day, although the material is mostly a hard compact clay.

The nature of the ground to be excavated varies considerably, according to the locality.

In the basin which is being excavated at Colon the ground is mainly of blue clay, mixed with boulders of coral, which is dug very easily by the dredges, although an occasional block of coral has to be broken before being taken out of the buckets.

At Gatun, and from thence up the valley of the Chagres, the soil on the top is a heavy loam, from three to six feet in depth, and the balance is mainly hard yellow and blue clay, which is very compact.

Work was commenced by the first dredge, "The Count de Lesseps," in the beginning of 1884, and has been continued steadily ever since. The second dredge brought to the Isthmus, the "Prosper Huerne," was destroyed by fire when nearly completed, and consequently the work was delayed considerably. Since then the fleet of dredges has been constantly increased until the 15th of January of this year, when the last addition, the "City of New-York," commenced work, making in all seven dredges now at work on this contract.

The work done up to the 31st of January, 1886, measures 11 kilometres of main canal, 50 metres in width, and an average depth of five metres, and three and one-half kilometres of auxiliary canal, 40 metres wide and four metres deep.

The excavation of the main canal is at three different places, as follows:

Colon to Mindi, 4.600 kilometres; at Gatun, 4.700; at Caimintu, 1.700; total, 11 kilometres.

The total amount of work done up to the 31st of December, 1885, amounted to 4,474,000 cubic metres; month of January, 1886, 728,000; total to January 31st, 1886, 5,202,000 cubic metres.

The work for the month of January, 1886, was done by the complete fleet of creation of such machines, art and science have reached a limit in any direction.

That the Canal Company are alive to these considerations may be inferred from the fact, which I have learned since my return, that eight new dredges and thirty-four new excavators are now constructing for its use, and that the contractors, for their own account, have an order in New-York for 110 new locomotives. It has also transpired within a few weeks that the Dutch Company, who have the contract for the Culebra cut, and whose work is so much behind, have just ordered one or more excavators of a new design, constructed at Glons, near Liege, in Belgium, each excavator weighing five tons and representing seventy horse-power, which are reported to be more efficient than anything now on the Isthmus.

The troubles which our Chinese colonists are experiencing on the Pacific coast may lead them to turn their steps toward the Isthmus. If so, the supply of manual labor would only be limited by the resources of the Company. Thus far, however, the representation of the Mongolian races on the Isthmus is quite limited. But in a case like this, where economy of time is to so great a degree economy of money, something more effective and less costly, not to say more humane, must be much more generally substituted for human labor on the canal, however abundant the supply of human labor may become.

FINANCIAL SITUATION AND PROSPECTS.

Of the amount already expended upon the canal I have no information, except what may be gathered from the reports of the Company. I was informed by the Vice-President, however, that the Company had in its treasury sufficient to carry it through the current year.

The reports show the receipts of the Company from all sources, including the late call of 125 francs per share from the stockholders, to be as follows :

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seven dredges, which gives an average of 104,000 cubic metres per dredge for the month.

There is no doubt but that the American Contracting and Dredging Company will have their work finished at the time stipulated in the contract, namely the 1st of December, 1887.

Capital, 300,000,000 francs, of which 375 francs per share have been called for, and I presume are now paid up,...........fcs.	225,000,000
Bonds at 3 per cent,..	171,000,000
" 4 "	129,000,000
Benefices de tresorerie premiums,..............................	21,300,000
	fcs. 546,300,000
Or say, in round numbers,..................................	$109,260,000

The International Congress of 1879, the parent of the Panama Canal Company, estimated its probable cost, including the accessory works of derivation, harbors, basins, turn-outs, etc., at 1,070,000,000 francs, say $214,000,000.

At the close of the present year, therefore, should the rate of expenditure not be increased nor any debts be incurred, there will remain of the original estimate unexpended $140,740,000. If these figures can be trusted, about half of the estimated cost will have been expended by the close of the year, while at least four-fifths of the excavation, not to speak of supplementary or precautionary work, will remain to be executed.

This will seem, on the face of it, to be a rather discouraging exhibit for those who counted upon a completion of the work within the original estimates. But it is not quite so discouraging as it seems. A much larger proportion of this expenditure has been made on preparations for digging the canal than upon the canal itself. But those preparations were indispensable. As I have already stated, it was necessary to provide everything, the country contributing practically nothing but material to be removed, and nothing to remove it with.

Houses had to be imported for the shelter of the officers and men ; forty or fifty hospitals to be built and equipped with physicians and nurses ; wharves and warehouses for landing and storing supplies ; machine shops for the construction of most and the reparation of all the machinery required on the work ; two or three hundred miles of railway track, with the locomotives and cars to equip it, and so on.

Besides which, the expenses which preceded and attended the organization of the Company, its administration since and its interest engagements, make a formidable aggregate. Mr. DE LESSEPS, in his report made in July of last year, gives as the sum realized for the prosecution of the canal to that date, 471,300,000 francs ; expenditure on it, 368,260,896 francs.

Of the latter sum considerably less than 115,000,000 francs were spent upon the canal proper, as appears from the following analysis of these expenditures accompanying his report :

Cost of Charter,...fcs.	10,000,000
Guaranty, deposited with the Columbian Government,..........	750,000
Expenses of every nature incurred before the organization of the Company,..	23,393,605
Re-imbursements of advances to the founders,....................	2,000,000
Cost of administration on the Isthmus and at Paris from the beginning, (1879,),..	26,415,927
Obligatory charges upon the Company, (*les charges sociales obligatoires,*)...	26,036,551
Interest paid on stock and bonds,..............................	55,700,148
Various structures erected on the Isthmus, lands purchased, &c.,.	25,289,743
Material and supplies,...	83,537,568
Clearing the surface of the wood and stumps, installing machinery and excavation, ...	115,137,354
Total,...fcs.	368,260,896

It will be observed that the last item only, and that partially, represents work on the canal. It would be very misleading, therefore, to infer the cost of the work remaining to be done from the apparent cost of what has been done. Fully two-thirds of the expenses already incurred are in the form of plant, which will involve no future expense except for interest and deterioration.*

It would be scarcely more fallacious to infer, that because say one-fifth of the excavation had been made at a cost of 115,000,000 of francs, if it has been, the canal could be completed for four times that sum additional, say 460,000,000 of francs.

No doubt some of the money has been injudiciously expended, but what great work, whether of a private or public character, has escaped this reproach ?

Taking the waste through these channels at the largest presumable figures, the inconsiderate expenses of the average individual all over the world would probably represent a larger per centage of his aggregate expenditures.

The Suez Canal cost about $100,000,000. It could, no doubt, be duplicated to-day for two-thirds that sum. Its shareholders had to wait thirteen years before they were assured that the capital they had embarked in that enterprise would ever yield them any return, and in the sixth year of its progress the Suez Canal shares were selling far below the present price of the shares of the Panama Canal. The Society of English Engineers, who in 1881 elected Mr. DE LESSEPS one of its members by a unanimous vote, only twenty years before had declared that the level of the Mediterranean was thirty feet below the level of the Red Sea, and that a canal there was a chimera. It was the judgment of our own best engineers that the first railway across the North American continent could never be self-sustaining, and so general was this conviction that the Government not only lent its credit to the enterprise, but endowed it with a principality of land, from which the Union Pacific fragment alone is realizing from three to five millions of dollars annually. That work for many years yielded to its stockholders eight per cent. a year, and would be now far more remunerative, but for the construction of four or five competing lines, and for a policy towards it anything but friendly, on the part of the Federal Congress.

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* The interest is 5 per cent. The deterioration on engines, machinery and all metal work is not less than 10 per cent., and on wood work, houses, wharves, &c., from 20 to 30 per cent.

While these experiences teach us to beware of rushing to hasty conclusions about the practicability and cost of a work, in the success of which the whole world has such a substantial interest, it must not be overlooked that the difficulties to be overcome are far more formidable than any with which private enterprise has ever yet successfully contended; and after making every allowance, and it should be a liberal one, for the light derived from past experience, from the progress of science, and from the increasing wealth in the world, it still requires a very robust faith to believe that the Panama Canal can be opened for navigation from sea to sea for an additional sum no larger than the net proceeds of the new loan of $120,000,000, which Mr. DE LESSEPS is now soliciting. And yet I know of no person who is competent to say with authority that it cannot be. It would be difficult to name any great enterprise of which, during a considerable part of its period of gestation, the "wise" and the "conservative," a class whose money is usually already well invested, did not say it was impossible or impracticable. The projectors of our first trans-continental railway were deemed cranks in their day; the Erie Canal project was denounced as chimerical, and even the Hudson River Railroad had been running twenty years before everybody was convinced that Mr. BOORMAN was not in his dotage when he conceived and commended it to the public as a practical financial enterprise.

The average man is rather more liable to underrate than to overrate the combined resources of science and wealth, when employed in objects calculated to promote the common welfare of human society.

The Panama Canal has suffered from a lack of unity of policy in its management. In the five years of its progress it has had seven directors general, or superintendents of work, on the Isthmus. No one of them remained two whole years, I believe. How far this is chronic, how far it is an inevitable incident to such a work in that country, and how far it shall prove to have been the result of errors which experience may correct, I am not competent to judge. But the disadvantage of such frequent interruptions of the traditions of the administration, and the waste of valuable experience accumulated by these officers respectively, can hardly be exaggerated.

The central administration professes to be fully alive to them, and the distinguished gentleman* who has recently succeeded to the responsible post of Director General, has been selected, I am told, in the confident expectation that the pretext for this reproach shall not recur.

That with sufficient means the canal can be built, is, I believe, no longer a question among engineers who have visited the works and seen what has already been accomplished. It seems probable, too, that when finished it can be kept in order and operated at a smaller per centage, upon the lowest estimate of its earnings, than any other artificial water-way in the world. The banks of that portion of the canal that run through rock will of course take care of themselves. The banks of that portion that run through soil and swamp will, in a single season, be so compactly bound together by the roots of tropical vegetation as to defy effectually any disturbing forces to which it will be exposed. Unlike the railway every constituent of which is constantly and rapidly deteriorating, nothing perishable enters into the construction of the canal. On the contrary, the climate, which is such a formidable enemy to its construction, becomes its best friend the moment it is completed. If the railway were left to itself, without repairs, it would be difficult to find a trace of it in ten or fifteen years, while the canal, except at the mouth of the Rio Grande River, is daily strengthening its entrenchments, and, once completed, will, in all probability, become as permanent a water-way as the Chagres. Nor is it certain that the current, of from seven to ten miles an hour, which would pour through it at every change of the tide, would not scour it from end to end as effectually as dredges.

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* Mr. BOYER, Director General of Works and Engineer in Chief of Bridges and Roads.

Whether the revenues of this canal will ever remunerate the stockholders for its cost, is a question about which I have not sufficient data to form an opinion, and, if I had formed one, it would hardly become me to express it to the body over which you preside. But this, I think, I may say, with perfect propriety, that if all the pecuniary advantages which would inure to the world from breaking down the wall of partition which separates, by many thousands of miles, one-fourth of the population of the globe from the other three-fourths, could be secured to the stockholders of the Canal Company, the question of its cost would be the least of their concerns. Unhappily, they can only hope to receive three dollars a ton on the shipping which they pass through the canal, but will have no share in the incalculable advantages which will accrue to all the nations of the earth from the prodigious impulse it would give to their respective industries and commerce. Were all nations to contribute towards its construction, in any equitable proportion to the advantages they would derive from it, the stock would be as difficult to obtain as the golden apples of Atalante.

The tonnage, which would take advantage of the canal the first year, has been variously estimated at from three to ten millions. The estimate upon which Mr. DE LESSEPS has been in the habit of basing his calculations, was about six millions.

Admiral DAVIS, of the United States Navy, estimated the tonnage that would have passed the Isthmus in 1866, had the canal been then in operation, at 3,094,070 tons, of the value of $467,831,130, insuring an economy to the commerce of the world of $49,530,208.

He also estimated the tonnage passing the canal at the expiration of ten years from its opening, that is, in 1876, at 6,188,140 tons.*

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* *Some of the Estimates of the Amount of Tonnage that would use the Canal.*

	Tons.
Dr. LONG, American Consul at Panama,	3,000,000
Admiral AMMON,	3,762,000
San Francisco Board of Trade,	5,000,000
Admiral DAVIS,	3,094,070
M. DE LESSEPS,	6,000,000
M. LEVASSEUR,	7,500,000
The *Capitaliste*, of Paris,	10,000,000
M. MONOCAL,	between 5,000,000 and 6,000,000
M. CORTHELL,	7,000,000

In none of the estimates which have fallen under my eye, except that of M. **Levasseur**, has any account been taken of the five

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A writer in the *Revue-Gazette Maritime et Commerciale of France,* assuming that the Panama Canal had been opened for navigation in 1884, has made the following estimate of the traffic through it for that year, based on statistics published by the Government at Washington:

EUROPE.—*Commercial movement between the Nations of Europe and the Countries on the Pacific and Oceanica.*

	Ships.	*Tons.*
England,	2,167	2,458,313
France,	666	807,236
Spain,	333	663,214
Germany,	430	305,111
Belgium,	120	123,891
Sweden,	95	67,185
Holland,	47	60,849
Italy,	99	49,465
Norway,	58	41,407
Portugal,	56	28,358
Austria,	17	22,829
Denmark,	29	17,898
Russia,	9	4,634
	4,126	4,650,390

ASIA.—*Commerce between the Countries of Asia and the Countries lying on the Atlantic.*

ARRIVALS AND DEPARTURES.

Intercourse of the East Indies with the West Indies.	*Ships.*	*Tons.*
Guiana, &c,	93	100,798
Japan,	485	533,470
China,	....	....
Sail Ships,	1,677	577,910
	2,255	1,212,178

AMERICA.—*Movement of Commerce between the United States lying on the Pacific Coast to Europe, between the United States lying on the Atlantic and the Countries of the Pacific and Oceanica, and between the United States on the Atlantic and those on the Pacific.*

	Ships.	*Tons.*
Between the States on the Pacific and Europe,	778	1,015,908
Between the Atlantic States and the Nations on the Pacific,	1,008	873,828
Between the Atlantic States and Oceanica,	1,126	1,431,200
Between the Atlantic and the Pacific States,	75	120,662
	2,987	3,441,598

trans-continental railways, all of comparatively recent construction, with which the canal will have to compete. One of these is through British territory, and will naturally have the sympathies of the British Government and of British merchants, for whatever sympathy in matters of this sort is worth. As the United States continental roads have been in the habit for many years of subsidizing the Pacific Mail Steamship Company, in the benefits of which the Panama Railroad participates, the presumption is, that the canal will have greatly the advantage in this competition ; but experience, as well as reason, teaches us that neither the railways nor the canal will get as much business as either might expect if its competitors did not exist, unless it was made up of new business which their ampler facilities of transportation are destined to develop.

All of the estimates of the traffic that have been hazarded, even those made by experts, whether selected by our own and European Governments or by the Canal Company, must at best be largely conjectural.

I do not propose to add to their number, though I will venture to signalize the curious and remarkable fact, that the product of any new facility of transportation, whether of passengers, merchandise or intelligence, by rail, by steamships, by telegraph or by telephone, has increased in a ratio far transcending the expectation of its most sanguine projectors.

The Suez Canal yielded a revenue from its transit tolls of less than $900,000 the first year of its operation. In ten years it yielded eight times that sum, and is now yielding an annual income of more than $12,000,000.*

RECAPITULATION.

	Ships.	*Tons.*
Europe,	4,226	4,650,390
Asia,	2,255	1,212,178
America,	2,987	3,441,598
	9,468	9,304,166

Should the Asiatic contingent be thought debatable, there would remain 7,213 ships, with 8,091,988 aggregate tonnage, which, at $3 per ton, would yield 121,000,000 francs ($24,200,000) annually, or more than 10 per cent. on $240,000,000.

* The following table of the transit business of the Suez Canal is taken from the *Revue-Gazette Maritime et Commerciale* of January 1, 1886 :

Costing originally a trifle less than $100,000,000, at its present market price it would bring $260,000,000, which is about $20,000,000 more than the original estimate of the total cost of the Panama Canal.

The directors of the Suez Canal already realize its inadequacy for the business that offers, and have taken measures to enlarge it to double its present capacity. The impulse that work has given to commerce is already felt at every important maritime centre. Italy is constructing a harbor at Assab for the accommodation of a new line of postal steamers on the Red Sea. France is establishing herself at Obock, Sagallo and Tadjourah; has signed a commercial treaty with Burmah, and has organized a new monthly steam line to Tonquin. Germany is establishing two new lines of monthly steamers, one to China and Japan and one to Australia.

A company has just been formed at Hamburg to trade with Borneo, New-Guinea and other islands of the Pacific; Austria has chartered an Austrio-Asiatic Company to trade with the far East, and Portugal, the "Timor and Macao Company," to trade with those possessions; Spain has reduced by half her tariff on imports and exports in favor of her Philippine possessions; Holland is building railroads in Java; Australia, also, has 1,500 miles of rail-

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YEARS.	*Number of Ships.*	*Net Tonnage.*	*Receipts from Tolls.*
1870,	486	436,609,370	fcs. 4,345,758 42
1871,	765	761,467,050	7,595,385 13
1872,	1,082	1,160,743,542	14,377,092 17
1873,	1,173	1,367,767,820	20,850,726 15
1874,	1,264	1,631,650,140	22,667,791 94
1875,	1,494	2,009,984,091	26,430,790 61
1876,	1,457	2,096,771,613	27,631,458 20
1877,	1,663	2,355,447,695	30,180,928 72
1878,	1,593	2,269,376,315	28,345,672 87
1879,	1,477	2,263,332,194	27,131,116 77
1880,	2,026	3,057,421,881	36,492,620 25
1881,	2,727	4,136,779,769	47,193,882 67
1882,	3,198	5,074,808,885	55,421,039 59
1883,	3,307	5,775,861,795	60,558,488 57
1884,	3,284	5,871,500,925	58,628,759 82
1885,	3,624	....	62,199,990 03

The number of passengers crossing were:

1870,	26,758	paying francs,	263,552
1880,	101,551	" "	1,075,517
1884,	151,916	" "	1,519,160

way under contract, and England is constantly and rapidly expanding her railway system in India. Who shall say that any considerable portion, if one of these investments would have been made, if it were still necessary for European shipping to double the Cape of Good Hope to reach the Indian Ocean?

I cite these facts and figures chiefly to illustrate the law of growth of a canal property which certainly does not appear to open to the commercial world as extensive or as important a field for the employment of capital as will be opened by a ship canal through the Andes, that would shorten, by more than 6,000 miles, the voyage from New-York to Yokohama, and by more than 8,000 miles the voyage from New-York to San Francisco and all our Pacific territory; and which, let me add, will secure to the United States, forever, the incontestible advantage of position in the impending contest of the nations for the supremacy of the seas.

No nation would feel so promptly as the United States the influence of a canal that would shorten, by some 8,000 miles, the voyage between her Atlantic and Pacific seaports. It would give an incalculable impulse to her privileged coastwise traffic; it would tend to develop among her young men a taste for the seafaring life, and to train a reserve of able seamen, fitted for those emergencies to which a nation like ours, with seven or eight thousand miles of seacoast, is always more or less exposed.

Long, and, I fear, tedious as my story is already, I am conscious that I have answered none of the questious about which the members of the Chamber of Commerce are most curious. I have not ventured an opinion as to the time when the canal will be completed, nor as to its total cost, nor as to the revenue it can earn, nor even as to the probabilities of the required means being provided for its prosecution.

To determine when the canal will be finished, one must know, first, how much work is yet to be done; and, second, how much money the Company will be able and disposed to spend annually upon it; and, third, how many laborers or their equivalent in machines it can command. That information has not yet been revealed to man. No one living can even now give anything more than a guess as to the amount of work to be done. No one knows whether the Company will decide to build a dam or carry off the waters of the Chagres some other way. No one knows what slope it will be necessary to give the cut at Culebra, nor what obstructions the workmen may have to encounter from subterranean water courses as they descend. Nor does any one know how much submarine rock may be encountered in the channel of the canal, at or near the extremities, nor how much or little pumping, coffer-damming and blasting may be necessary to remove it. Of course, without knowing approximately, at least, how much work is to be done, it is not possible to give anything better than a guess about the cost of doing it; but, even if we did know the amount of work; in determining the time and cost of doing it, it would not help us much, in that climate and so far from every base of supplies. Till we know how many men and how many machines of ascertained capacity can be counted upon, we have no data for an estimate that would conduct to any satisfactory conclusion. All these uncertain elements are rendered more uncertain by the financial situation of the Company. It is about entering the market for a new loan of 600,000,000 francs. The price it will have to pay for this money is uncertain, and the price of a future loan, if one should become necessary, is still more uncertain. Till the money is secured, and the cost of getting it ascertained, it would be about as safe to predict the quarter in which the winds will be setting next Christmas day at St. Petersburgh, as the time when the canal will be finished or what it will cost. And, for aught I see, this uncertainty must last until near the completion of the work, for nowhere in the world is the unexpected more certain to happen than on such a work at Panama. It is destined to be, from first to last, experimental, and every day the plans of the day before are liable to unsuspected modifications. That the canal will now be prosecuted to its completion, without any very serious interruption, is fairly to be presumed, for too large a proportion of its cost has already been incurred to make a retreat as good policy as an advance. Even if abandoned by the Company, the contractors themselves would probably find it for their interest to combine and finish it.

Now that the Committee of the Legislative Chambers of France has reported in favor of allowing the Company to borrow in the open market $120,000,000 more, the presumption is that it will get the money. When its stock was first put upon the market, proffers of subscriptions were largely in excess of the requirements. Mr. DE LESSEPS has the confidence of the French people to a greater extent than any other citizen of that republic, for he is justly credited by them with the authorship of the one achievement of this half century in which they feel the greatest amount of unqualified pride. The firmness with which the price of its securities is sustained shows that this faith is unimpaired. The stock of the Panama Canal Company is not in the hands of bankers or brokers or stockjobbers to any such extent as to bring the causes of this firmness under suspicion. It is mostly held by what Mr. DE LESSEPS calls the *petites bourses*, or small capitalists; by the people of small means, who prefer to confide their little economies to Mr. DE LESSEPS than to the bankers, partly because they know he does not job in the securities of the Company, partly because they were rewarded so handsomely for trusting to his representations about the Suez Canal, and partly because the construction of the Panama Canal under his auspices would rank among the half dozen largest contributions ever made to the permanent glory of France. It is a remarkable fact, that of the 104,345 shares of stock issued up to this year, 99,982, or all but 4,363 shares, were held in blocks of less than 21 shares, 80,839 shares, or nearly four-fifths, were held in blocks of from one to five shares, representing an investment of from $100 to $500.*

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* *Classification of the Stockholders of the Panama Canal.*

From	1	to	5	shares,	80,839
"	6	"	20	"	19,143
"	21	"	50	"	3,208
"	51	"	100	"	554
"	101	"	200	"	347
"	201	"	300	"	142
"	301	"	400	"	29
"	401	"	500	"	37
"	501	"	600	"	7
"	601	"	700	"	12
"	701	"	800	"	2
"	801	"	900	"	3
"	901	"	1,000	"	8
"	1,000 and upwards,				14

In the following extract from a speech which Mr. DE LESSEPS delivered before the Topographical Society of France some months ago, we may find at least a partial explanation of his wonderful hold upon the affections and confidence of the French people, to whom he has never appealed in vain:

"There is one thing in the attacks of which I have been the object which I have felt. I do not, of course, speak of the assaults of vagabonds; to them I pay no heed, for the world is better than it is commonly supposed to be; there are more honest people than scamps. [Applause.] Yes, there is one line of attack to which I am sensitive, because, though aimed perfidiously, it has an appearance of justice. It is when I am charged with taking 600,000,000 of money out of France to build the Suez Canal and enrich a foreign country. True, the

It was the same with the Suez Canal. Half of the shares of that Company—223,800—were taken by 22,229 persons, or in blocks averaging less than ten shares for each stockholder.

There is no evidence that the *petites bourses* in France have lost their faith in Mr. de Lesseps, nor am I aware of any reason for supposing that the inducements for the original subscription have lost any portion of their weight or value in the eyes of the class which paid for the Suez Canal, and have contributed more than $100,000,000 towards the Canal at Panama.

It was never my good fortune, as you were aware, Mr. President, when you designated me to be the representative of your Chamber at Panama, to have been trained either as an engineer or as a financier. Had I been, I could no doubt have fulfilled my mission less inadequately, but I feel that it would ill become me in this communication to apologize for any disadvantages under which I labor in common with Mr. de Lesseps.

I am, with great respect,

Your very obedient servant,

John Bigelow.

Suez Canal is not in France. But do you know what the Suez Canal has already yielded to France?—1,250,000,000 francs. I give you the exact sum on official authority. In this faith it has happened, that at the birth of each of my children I have purchased for them shares of the Suez or Panama Canals. My wife's *dot* of 100,000 francs, which I put into Suez stock the day of my marriage, represents to-day 2,000,000 francs.

"So it is 250,000,000, with the interest on the capital invested, and with the price of the machinery we have purchased in France, which the Suez Canal has sent home to us; and when I am accused of sending money from France to Egypt, I reply that this money is sent back tenfold, and more is coming; and that the same will be the case with the Panama Canal. What we shall spend in Panama will bring back to our country two or three millions.

"All that I possess I have gained through these works. I abandoned diplomacy in debt to my bankers some 30,000 francs. I had been ambassador to Spain and to Rome, where I spent all I received. It has been by the proceeds of my Canal work that I have at last been able to purchase a house for my family—a property which no one begrudges me, for it is the fruit of my own industry. [Applause.] I have been encamped all my life; it is but just that by this time I have a home. [Applause.]

"I repeat, that I feel the reproach which has been made that I do not work for my country. I do work for it; for the principal fruit of my labor returns to it, without reckoning the glory."

[illegible] Stanford Jun. University

Oak Spr[illegible] near [illegible]
Isle of Wight.

A LA MÉMOIRE

DE

L'ILLUSTRISSIME

CHRISTOPHE COLOMB

—

1492 - 1892

Leland Stanford Jun. University

Oak [illegible] near [illegible] Isle of Wight.

A LA MÉMOIRE

DE

L'ILLUSTRISSIME

CHRISTOPHE COLOMB

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1492 - 1892

AVIS

Les Lecteurs de cette brochure sont priés de la faire circuler parmi leurs amis et connaissances qui s'intéressent au Panama et de la communiquer aux journaux de leur pays, qui sont autorisés par l'auteur à en reproduire des extraits.

Le temps presse, et il est temps d'agir si on veut sauver l'entreprise de Panama.

Si quelqu'un peut trouver une combinaison meilleure et plus facile d'exécution que les miennes, je m'y rallie d'avance et toute mon énergie lui sera acquise.

Prière aux journaux qui publieront des extraits de cette brochure d'en envoyer un exemplaire à l'auteur.

A. BOUCARD,
225, High Holborn,
Londres W. C. (Angleterre).

SAUVETAGE

DU

PANAMA

INTRODUCTION

Il y a deux combinaisons pour sauver le **Panama**, tout en sauvegardant les intérêts des anciens porteurs et leur permettant même de rester les seuls propriétaires du Canal s'ils le jugent à propos.

Ce sont ces deux projets dont je donne plus loin un aperçu aussi explicite que possible, et je ne doute pas que si les anciens porteurs agissent au mieux de leurs intérêts, en me soutenant de toutes leurs forces dans la campagne que j'entreprends (*Le relèvement du Panama*), les travaux pourront être repris au plus tard le 1er janvier 1893.

L'auteur des deux projets que l'on va lire, libre de toute attache et de tous projets autres que les siens, est un des plus gros porteurs de titres, titres dont la majeure partie ont été achetés à l'époque où chacun avait la plus aveugle confiance dans les paroles du *baron Ferdinand de Lesseps*, et qui lui ont coûté la presque totalité d'une fortune péniblement acquise, après trente années de travaux scientifiques et industriels. Quand la débâcle est venue, l'auteur a été de nouveau obligé de se remettre dans les affaires comme auparavant ; mais ce qui aurait été un grand malheur pour beaucoup ne l'a pas été pour lui, car il appartient à une de ces natures qui ne peuvent rester inactives, et tout en dirigeant ses nombreuses entreprises industrielles et scientifiques, il a encore trouvé le temps nécessaire de s'occuper d'une manière toute spéciale du Panama et a publié de sérieux articles sur le Canal en 1891 (1). L'auteur était à Panama en exploration scientifique, quand la Commission présidée par M. N. Wyse Bonaparte fit ses premières études dans l'isthme. Pendant une vingtaine d'années il a voyagé et exploré l'Amérique du Nord, le Mexique, l'Amérique Centrale, Panama ; il a doublé le cap Horn et s'est arrêté pendant quelque temps au Chili. Il connaît donc bien tous ces pays et est à même d'apprécier à sa juste valeur l'importance d'une communication maritime entre les deux Océans. En 1878, il représentait la République de Guatemala au Congrès géographique de Paris, qui s'est occupé tout spécialement du Canal de Panama. Depuis cette époque, il a suivi attentivement tout ce qui a été fait jusqu'à ce jour, et son opinion actuelle est tellement favorable au Canal à tous les points de vue, et surtout au point de vue commercial, qu'il est convaincu que même si le Canal de Nicaragua se faisait, le Canal de Panama serait encore une bonne affaire et qu'à une époque peu éloignée, le revenu des deux Canaux serait en proportion avec les efforts faits pour mener à bonne fin ces travaux gigantesques. Il est même certain qu'un jour ou l'autre ces deux Canaux seront ouverts à la grande satisfaction du monde entier et qu'une entente se fera entre les deux Compagnies pour que l'un des canaux serve exclusivement à l'aller et l'autre au retour.

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(1) Voir le journal *The Humming Bird*, 1892, pages 3, 10, 20, 29, 44 et 97, édité à Londres par l'auteur.

Mais, pour le moment, il y a tout avantage à conclure celui de Panama qui est très avancé et qui pourra certainement être inauguré au plus tard le 1er janvier 1900, et l'auteur espère même être un de ceux qui assisteront à cette inauguration solennelle, qui fera époque dans l'histoire du **Vingtième Siècle.**

Il ne me reste plus qu'à ajouter quelques mots. D'après des dépêches qui viennent d'arriver à Londres, on annonce la visite à Chicago, en octobre prochain, de Son Excellence don Raphaël Nunez, Président de la République de Colombie. On dit qu'il vient assister aux fêtes données à l'occasion de la première Inauguration officielle de l'Exposition internationale de Chicago.

Pour qui sait lire entre les lignes, il est clair que, *si cette nouvelle est vraie*, M. Raphaël Nunez, Diplomate des plus distingués et la personnalité la plus éminente de la Colombie, complètement dévoué aux intérêts de son pays, ne ferait pas un voyage de ce genre, simplement pour assister aux fêtes de l'Exposition de Chicago.

Mais il est plutôt probable que n'ayant plus qu'une médiocre confiance dans la continuation des travaux du Canal, en février 1893, par une compagnie française, il prend les devants et se décide à faire ce long et pénible voyage, pour une personne de son âge, avec l'intention de conférer, soit avec le gouvernement, soit avec des capitalistes américains, pour passer un traité préliminaire avec eux pour la reprise des travaux, dans le cas ou la Compagnie internationale du Canal Interocéanique perdrait ses droits.

Mais c'est ici que se place un incident qui, si ma mémoire est bonne, empêche soit M. le Président Nunez, soit les Américains ou autres de pouvoir rien conclure sans l'assentiment de l'ancienne Compagnie de Panama.

Pendant mon séjour à Panama et aux Etats-Unis, j'ai connu les hautes personnalités qui dirigeaient the Panama Railway Cy (la Compagnie du chemin de fer de Panama), soit à New-York, soit dans l'isthme ; et à l'occasion de la Commission internationale d'études envoyée dans l'isthme en 1876-1877, époque pendant laquelle je me trouvais dans ce pays, j'eus l'occasion de causer maintes et maintes fois du canal avec les Directeurs et Inspecteurs de la Compagnie du chemin de fer, et je me rappelle encore, comme si c'était hier, que ces messieurs m'ont toujours dit qu'aucun Canal ne pouvait se faire, à moins de soixante lieues au-dessus ou au-dessous de la ligne du chemin de fer, sans l'assentiment de la Compagnie.

C'est même, je crois, ce qui obligea le baron Ferdinand de Lesseps à acheter le chemin de fer de Panama, achat que j'ai toujours considéré comme une des meilleurs affaires commerciales faites par l'ancienne Compagnie du Canal, achat qui, du reste, était obligatoire du moment que l'on avait décidé l'ouverture du Canal dans l'isthme de Panama.

A l'heure actuelle, la Compagnie du canal étant propriétaire du chemin de fer de Panama, y compris ses charges et ses privilèges, personne ne peut continuer les travaux du Canal sans son assentiment.

Pour ma part, je défendrai ce point jusqu'à mon dernier souffle, et j'espère que la majorité des Actionnaires et Obligataires me soutiendront dans cette revendication, si elle devenait nécessaire.

Il se peut que la Compagnie du Canal soit obligée d'abandonner tous les matériaux et les propriétés existants à Panama, mais personne ne peut l'obliger à se dessaisir de ses droits sans une rémunération largement équivalente, et c'est à obtenir cette rémunération que je me mets à la disposition des porteurs de titres de Panama.

TABLEAU DES DISTANCES
EN MILLES NAUTIQUES
ENTRE LES PRINCIPAUX PORTS DU MONDE

Par les routes du cap Horn,
du détroit de Magellan, du cap de Bonne-Espérance
et du Canal de Panama
Et montrant à quelques milles près le grand avantage
qu'il y aura pour les navires
en passant par le Canal de Panama.

ENTRE	Par le Cap Horn par navires à voiles.	Détroit de Magellan par steamer.	Cap de Bonne-Espérance.	Voie Panama.	Avantage pour les navires à voile.	Avantage pour les steamers.
Havre, Anvers, Londres, Liverpool et San Francisco.	15 620	13 494	. . .	7 627	7 983	5 867
Acapulco.	. . .	11 875	. . .	5 765	. . .	6 110
» Mazatlan	. . .	12 337	. . .	6 395	. . .	5 962
» Guayaquil.	. . .	10 620	. . .	5 947	. . .	4 676
» Callao	. . .	9 960	. . .	6 464	. . .	3 493
» Valparaiso	9 380	8 760	. . .	7 734	1 646	1 025
» Honolula	. . .	13 610	. . .	9 137	. . .	4 472
» Yokohama	. . .	. . .	14 505	11 947	. . .	2 583
New-York et San Francisco.	15 650	13 174	. . .	5 000	10 650	8 174
» Sitka.	. . .	14 439	. . .	6 277	. . .	8 162
» Détroit de Behring.	. . .	15 705	. . .	7 495	. . .	8 210
» Acapulco	. . .	11 555	. . .	3 138	. . .	8 417
» Mazatlan	. . .	12 087	. . .	3 768	. . .	8 319
» Hong Kong	. . .	. . .	13 750	10 785	2 965	. . .
» Yokohama.	. . .	. . .	15 217	9 320	5 897	. . .
» Melbourne	13 760	12 860	12 830	9 965	3 795	2 895
» Honolulu.	15 480	13 290	. . .	6 580	8 900	6 710
» Guayaquil.	. . .	10 300	. . .	3 083	. . .	7 217
» Callao	. . .	9 640	. . .	3 600	. . .	5 040
» Valparaiso	9 420	8 440	. . .	4 870	4 550	3 570
Nouv.-Orléans et San-Francisco.	16 000	13 539	. . .	4 230	11 770	9 309
» Acapulco.	. . .	11 920	. . .	2 968	. . .	8 952
» Mazatlan.	. . .	12 402	. .	2 998	. . .	9 404
» Callao.	. .	10 005	. . .	2 884	. . .	7 121
» Valparaiso	. . .	8 805	. . .	4 154	. . .	4 651

PREMIER PROJET

PROJET DE SOUSCRIPTION (1)

POUR

LA FORMATION D'UNE COMPAGNIE ANONYME

SOUS LE NOM DE

COMPAGNIE DU CANAL INTEROCÉANIQUE
DE COLOMB
pour l'achèvement du Canal, dénommé jusquà ce jour
CANAL INTEROCÉANIQUE DE PANAMA.

CAPITAL : UN MILLIARD DE FRANCS, divisé en deux millions d'Actions de 500 francs.

Payables comme il suit : 25 francs en souscrivant, 25 francs à la répartition, le restant à des intervalles de six mois au moins, en actions ou en obligations de la Compagnie de Panama, en liquidation, aux taux suivants :

Actions de 500 francs.	à 125	francs l'une.
Obligations 5 °/o	à 220	—
— 3 °/o	à 150	—
— 4 °/o	à 165	—
— 6 °/o 1re et 2e séries	à 220	—
Obligations à lots, tout payé. .	à 220	—

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(1) Souscription exclusivement réservée aux porteurs de Panama.

Dans le cas où il serait possible de conclure un arrangement avec les Sociétés Civiles dépositaires des sommes de remboursement et payement des Lots, des Obligations à lots et des Obligations 6 °/₀ 3ᵉ série, pour que le montant de ces dépôts soit versé à la nouvelle Compagnie, elle recevrait les dites Obligations en payement aux taux suivants :

Obligations 6°/₀ 3ᵉ série. . . .	à 220 francs l'une.
Bons à lots.	à 100 —

Mais, à mon avis, il vaudrait peut-être mieux laisser de côté les obligations 6 pour 100, 3ᵉ série, et les bons à lots dans les mains des Sociétés civiles, et se faire rendre les 30 francs versés par la liquidation, sur les 750,903 obligations non placées et à annuler.

De ce chef, on aurait à recevoir de la société civile 38 millions 774,602, francs 96 centimes et 386,641 francs 23 centimes dus par cette Société à la Compagnie de Panama, selon situation du 31 décembre 1891, si cette dernière somme n'a pas encore été remboursée. Les porteurs d'actions et d'obligations pourront souscrire autant d'actions nouvelles de 500 francs qu'ils auront de titres anciens, à raison de deux actions anciennes pour une nouvelle, une obligations 3 pour 100 pour une action nouvelle, deux obligations 3 pour 100 ou 4 pour 100 pour une action nouvelle, une obligation 6 pour 100 pour une action nouvelle, une obligation à lots libérée pour une action nouvelle.

Au moment de l'émission, le porteur de deux actions anciennes, souscripteur à une action nouvelle devra livrer ses actions à la nouvelle Compagnie qui lui en donnera reçu à raison de 125 francs l'une, soit 250 francs pour les deux, et il n'aura plus à payer que 12 francs 50 centimes au moment de la souscription, 12 francs 50 centimes au moment de la répartition, et 20 francs 50 centimes, au lieu de 50 francs chaque fois que l'on fera un appel de fonds, c'est-à-dire chaque six mois.

Il en sera de même pour tous les autres titres de l'ancienne compagnie, comme il est expliqué plus loin.

Comme compensation, pour l'acceptation des anciens titres aux prix fixés ci-dessus; les anciens porteurs font l'abandon définitif et de plein gré du montant de tous coupons dus depuis trois ans passés, et de leurs titres, qui seront détruits.

Les Obligations à lots non placées et actuellement dans les mains de la liquidation sont annulées.

La liquidation remet à la nouvelle Compagnie les valeurs de toute nature : espèces, immeubles, matériaux, etc., existant soit à Paris, soit à Panama, qui deviennent, dès ce moment, la propriété exclusive de la nouvelle Compagnie.

Par ce moyen, toutes les valeurs, matériaux et propriétés de l'ancienne Compagnie restent dans les mains des anciens Actionnaires et Obligataires de la Compagnie de Panama, et ils conservent la presque certitude de récupérer toutes leurs pertes, et au-delà, à une époque plus ou moins éloignée.

Par le calcul suivant, qui a été fait avec soin, on verra qu'il est possible, tout en conservant l'affaire dans les mains des anciens porteurs, de réaliser une somme variant entre 500 et 600 millions en espèces, somme qui a été jugée plus que suffisante pour terminer les travaux.

En outre, le prix total du Canal, ainsi réduit à un milliard, redevient une excellente affaire comme placement, et tous les porteurs s'assurent un revenu très rémunérateur dès l'ouverture du Canal, et conservent une propriété qui aura un jour une grande valeur, dont il est tout à fait impossible de juger l'importance, tant elle sera considérable.

Valeur des anciens titres reçus en paiement par la nouvelle Compagnie.

600.000	actions à.	125 fr.	=	75 millions.	
520.000	obligations 5 0/0, à . . .	220 fr.	=	55 —	
600.000	— 3 0/0, à . . .	150 fr.	=	90 —	
477.387	— 4 0/0, à . . .	165 fr.	=	78 —	768.000 fr.
438.802	— 6 0/0, à. . . .	270 fr.	=	96 —	536.440 fr.
258.887	— 6 0/0, à . . .	220 fr.	=	56 —	955.140 fr.
		Total :		452 millions	259.580 fr.

ce qui laisserait à la disposition de la nouvelle compagnie la somme de 547 millions 740 mille 420 francs.

Ne sont pas portées en compte les obligations 6 pour 100, 3e série, ni les obligations à lots, libérées définitivement, ni les Obligations à lots, 110 francs payés, parce que les premières et les dernières représentent environ la même somme qui est déposée près des Sociétés civiles. Quant aux obligations à lots libérées, je crois qu'elles sont en très petit nombre et ne changeront presque rien à la somme acquise par la nouvelle compagnie.

Pour arriver à ce total de 547 millions 740 mille 420 francs, les porteurs des anciens titres n'auront à verser que des sommes relativement minimes, comme il est expliqué sur le tableau suivant :

	DEUX ACTIONS DE 500 fr. (*n'ayant plus droit à rien*), acceptées en paiement pour.		125 fr.	250 fr.
1	obligations 5 0/0 émise à.	437 50	à 220 »	220 »
2	— 3 0/0 — à.	285 »	à 150 »	300 »
2	— 4 0/0 — à.	333 »	à 165 »	330 »
1	— 4 0/0 — à.	450 »	à 220 »	220 »
1	— 6 0/0 1re et 2e séries à. . . .	440 »	à 220 »	220 »
1	— 6 0/0 3e série à 220 fr. (pour mémoire).			

1 obligation à lots, tout payé, émise à. . .	440 » à 220 »		220 »
3 bons à lots à 100 fr. (pour mémoire).			

DEUX ACTIONS DE 500 fr. auront donc droit à une action nouvelle de 500 fr., payables comme il suit :

2 *actions anciennes* à.	125 fr.		250 »
Souscription d'émission.		12 50	» »
A la répartition.		12 50	» »
Le 1er juillet 1893		20 50	» »
10 paiements intercalés depuis le 1er janvier 1894 au 1er juillet 1898 inclus. Chaque semestre à 20 f. 50. .		205 »	250 50
Total : fr.		250 50	500 50

UNE OBLIGATION 5 0/0 aura droit à une action nouvelle de 500 fr., payables comme il suit :

1 obligation ancienne à	220 fr.		220 »
Souscription —		12 50	» »
Répartition —		12 50	» »
11 paiements à partir du 1er juillet 1893 jusqu'au 1er juillet 1898 inclus, à 23 fr. 20		255 20	280 20
Total : fr.			500 20

DEUX OBLIGATIONS ANCIENNES 3 0/0 auront droit à une action nouvelle de 500 francs, payables comme il suit :

2 obligations anciennes à.	150 fr.		300 »
Souscription —		12 50	» »
Répartition —		12 50	» »
11 paiements semestriels du 1er juillet 1893 au 1er juillet 1898 inclus, à 16 francs.		176 »	201 »
Total : fr.		201 00	500 »

DEUX OBLIGATIONS ANCIENNES 4 0/0 auront droit à une action nouvelle de 500 francs, payables comme il suit :

2 obligations anciennes à	165 fr.		330 »
Souscription.		12 50	» »
Répartition —		12 50	» »
11 paiements semestriels, du 1er juillet 1893 au 1er juillet 1898 inclus, à 13 fr. 20 cent		145 20	170 20
Total : fr.		170 20	500 20

UNE OBLIGATION ANCIENNE 6 0/0, 1re ou 2e SÉRIE, aura droit à une action nouvelle de 500 fr., payables comme il suit :

1 obligation ancienne		220 fr.
Souscription	12 50	» »
Répartition	12 50	» »
11 paiements semestriels du 1er juillet 1893 au 1er juilet 1898 inclus, à 23 fr. 20	255 20	280 »
Total : fr.	280 20	500 20

UNE OBLIGATION 6 0/0, 3e SÉRIE acquerra les mêmes droits que celles de la 1re et de la 2e série, si la somme déposée à la Société civile est rendue à la nouvelle Compagnie.

UNE OBLIGATION A LOTS, LIBÉRÉE, aura droit à une action nouvelle de 500 fr., payables comme il suit :

Une obligation à lots, tout payé		220 fr.
Souscription	12 50	» »
Répartition	12 50	» »
11 paiements semestriels du 1er juillet 1893 au 1er juillet 1898 inclus, à raison de 23 fr. 20	255 20	280 20
Total : fr.	280 20	500 20

Dans le cas où la somme déposée en garantie à la société civile pourra être rendue à la nouvelle Compagnie,

Trois bons à lots auront droit à une action nouvelle de 500 fr., payables comme il suit :

TROIS BONS A LOTS à	100 fr.	300 »
Souscription	12 50	» »
Répartition	12 50	» »
11 paiements semestriels à partir du 1er juillet 1893 au 1er juillet 1898 inclus, à raison de 16 francs	176 »	201 »
Total : fr.	201 »	501 »

Maintenant voici un tableau des sommes que la nouvelle Compagnie aura à recevoir depuis le moment de l'émission jusqu'au 15 juillet 1898, époque de la dernière échéance.

Au moment de l'émission, soit le 1er janvier 1893.

300.000	actions souscrites par les porteurs des 600.000 actions anciennes à	12 50	3.750.000 fr.
250.000	actions nouvelles souscrites par les porteurs des 250.000 obligations 5 0/0 à	12 50	3.125.000 fr.
300.000	actions nouvelles souscrites par les porteurs des 600.000 obligations 3 0/0 à	12 50	3.750.000 fr.
238.694	actions nouvelles par les porteurs des 477.387 obligations 4 0/0 à.	12 50	2.983.675 fr.
438.802	actions nouvelles par les porteurs des 438.802 obligations 6 0/0 1re série . .	12 50	5.485.025 fr.
258.887	actions nouvelles par les porteurs obligations 6 0/0 2e série à.	12 50	3.236.087 50
1.786.383	Total]. Titres nouveaux . . . Total :		22.329.787 50
	Au moment de la répartition, soit le 1er février		22.329.787 50
	1893. Total :		44.659.575 f.

1er juillet 1893 et chaque semestre après, 11 paiements, 300.000 actions à 20 fr. 50	6.150.000 f.	= 11 paiem. =	67.650.000 f.
250.000 actions à 23 fr. 50, obligations 5 0/0	5.830.000 f.	= 11 paiem. =	64.130.000 f.
300.000 actions à 16 fr . . obligations 3 0/0	4.800.000 f.	= 11 paiem. =	52.800.000 f.
238.694 actions, obligations 4 0/0 à . . . . = à 13 fr. 20.	3.150.000 f.	= 11 paiem. =	34.658.368 f.
438.862 actions, obligations 6 0/0, 1re série = à 23 fr. 50.	10 180.206 40	= 11 paiem. =	111.982.962 f.
258.887 actions, obligations 6 0/0, 2e série à 23 fr. 20	6.006.178.40	= 11 paiem. =	66.067.962 40
A recevoir chaq. semestre	36.117.145.60		397.288.601 60

Plus 213.617 actions de 500 francs à placer si un arrangement ne peut se faire au sujet des obligations 6 0/0, 3e série et les bons à lots. Dans ce cas on aurait de ce chef. . . . . Total : 106.808.500 f.

Ce qui nous donnerait le grand total suivant :

Au moment de l'émission, millions	22.329.787 50
A la répartition —	22.329.787 50
Onze paiements semestriels sur 1.686.383 actions souscrites par les anciens porteurs de Panama à raison de 36 millions 117 mille 145 francs 60 cent. par semestre	397.288.601 60
213.617 actions à placer à 500 fr., l'une.	106.808.500 00
Total . . . . millions.	548.756.676 60

Soit cinq cent quarante huit millions, sept cent cinquante-six mille six cent soixante seize francs, soixante centimes (fr. 548,756,676, 60 c.), somme plus que suffisante pour faire face à toutes les éventualités et qui assurerait aux nouveaux actionnaires UN INTÉRÊT DE 3 p. 0/0, pendant toute la durée des travaux, *aussi bien pour les sommes payées en espèces que pour celles payées en titres de l'ancienne Compagnie*, comme il est expliqué sur le tableau ci-après.

Intérêts à payer pendant la durée des travaux.

Dû en janvier 1894 — Sur f.	22.329.784 50	12 mois	f. 669.913 53	
	23.329.784 50	11 —	609.012 30	
	36.117.145 »	6 —	496.757 17	
			1.775.683 »	
1895. — Sur 116.893.859 » 12 mois			3.506.815 77	4.003.562 94
Sur 036.117.145 » 6 mois.			0 496 777 »	
1896. — Sur 189.128.149 » 12 mois.			5.673.844 47	6.169.601 64
Sur 036.117.145 » 6 mois.			0.496.757 17	
			A reporter. .	11.948.847 58

			Report. . . .	11.948.847 58
1897. —	Sur 261.362.439 12 mois.	»	7.840.873 17	8.337.630 34
	Sur 036.117.145 6 mois.	»	4.096.757 17	
1898. —	Sur 333.596.729 12 mois.	»	10.007.901 87	10.504 659 40
	Sur 036.117.145 6 mois.	»	0.496.75717	
1899. —	Sur 405.831.019 12 mois.	»	12.174.930 57	12.670.687 47
	Sur 36.117.145 6 mois.	»	496.757 17	
			Total, fr. millions. . . .	43.466.824 70

A cette somme il y aurait encore à ajouter celle de trois millions, deux cent quatre mille, deux cent cinquante-cinq francs (3.204,255 francs), pour l'intérêt d'une année, dans le cas où il serait nécessaire de placer les 213,617 actions, en réserve dans les mains de la compagnie; mais, en réalité, la somme nécessaire pour payer les intérêts serait beaucoup moindre, car en plaçant judicieusement les sommes reçues en payement des actions nouvelles, et dont l'emploi ne serait pas immédiat, on pourrait réaliser des sommes importantes, qui diminueraient d'autant le total des intérêts à payer. Il se peut même qu'il existe une combinaison par laquelle en plaçant une partie des sommes reçues au moment de la formation de la Compagnie et après, sommes que l'on conserverait comme réserve pour effectuer les derniers payements en 1899, on parviendrait à reconstituer intégralement les sommes payées pour intérêts, pendant la durée des travaux.

Il ne me reste plus qu'à parler des frais d'émission, bureau, impression et livraison de titres, publicité, etc., etc., lesquels ont atteint des sommes considérables avec l'ancienne Compagnie. Mon avis est qu'ils ne sont pas nécessaires et qu'ils pourraient être réduits à un chiffre très modique. Si nous prenons comme base le dernier rapport publié le 2 avril 1892 par le conseil des mandataires de la Société civile pour l'amortissement des Obligations à lots du Canal de Panama, nous trouvons à l'actif sous la rubrique suivante :

Dépenses diverses. — Amortissements. — Capitalisation.

Divisibilité des versements : Frais de réception directe des versements	4.579 52
Frais divers d'administration et allocation aux commissaires.	18.824 20
Droits de garde des titres au crédit foncier	9.326 75
Total : fr.	32.740 47

ce qui me paraît très raisonnable. Il n'y a pas de raison pour que la nouvelle Compagnie ne puisse faire de même. Elle pourrait peut-être s'entendre avec les Administrateurs actuels de ladite Société civile pour que cette dernière se chargeât de la comptabilité de la nouvelle Compagnie.

Il en serait de même à Panama. On réduirait les frais de direction et de comptabilité au strict nécessaire en n'employant que des personnes qui offriraient toutes les garanties voulues, en donnant la préférence, aussi bien à Paris qu'à Panama, aux personnes qui seraient Actionnaires de la Compagnie. Quant à la rémunération attribuée aux Directeurs, elle serait limitée au strict nécessaire, disons 10,000 francs par an pour chacun jusqu'au jour où les Actionnaires recevraient un revenu annuel de 10 pour 100. A cette époque, les Directeurs auraient droit annuellement à 10 pour 100 du surplus des bénéfices à diviser entre eux, ce qui, avec les 10 pour 100 à payer au Gouvernement colombien, ferait 20 pour 100. Sur les 80 pour 100 restants, 40 pour 100 seraient placés en réserve, et les autres 40 pour cent seraient répartis aux Actionnaires. Il ne reste plus que les frais de publicité relatifs à l'émission de la nouvelle Compagnie. A mon avis, ces frais de publicité pourraient être très restreints : quelques milliers d'affiches et quelques articles dans les journaux sympathiques au relèvement de l'affaire, tels que le *Petit Journal*, le *Petit Parisien*, la *France*, la *Paix*, etc., etc., suffiraient.

En plus, il serait publié immédiatement par la nouvelle Compagnie un journal officiel paraissant une fois par semaine, au prix très modique de 15 centimes, ou 5 francs par an, pour les Actionnaires, accessible par conséquent à toutes les bourses.

Ce journal, dédié exclusivement aux affaires de la Compagnie tiendrait les actionnaires au courant de tous faits et gestes de la nouvelle Compagnie, aussi bien à Paris qu'à Panama. Il serait le lien indispensable entre les actionnaires et la compagnie, et remplacerait avantageusement les assemblées ordinaires annuelles d'actionnaires. Ceux-ci ne seraient convoqués que dans le cas de force majeure.

Si le Comité directeur jugeait utile de se servir de banquiers pour l'émission des actions de la nouvelle Compagnie, il sera stipulé avec lesdits Banquiers qu'on ne leur allouera que 1/4 pour 100 sur toutes les sommes encaissées pour le compte de la Compagnie, ce qui ferait 12 millions 500,000 francs à verser auxdits banquiers sur la somme de 500 millions.

Dans tout ce qui précède, on verra que l'auteur ne s'est occupé qu'à prouver qu'il est possible et facile même de se procurer les sommes nécessaires pour terminer les travaux du Canal. Il ne s'est occupé en quoi que ce soit de la question technique qui appartient de droit aux Ingénieurs, d'abord parce que ce travail n'est pas de sa compétence, et ensuite parce qu'il considère qu'il a été fait consciencieusement par les diverses Commissions d'Ingénieurs envoyées dans l'isthme exclusivement à cet effet, et surtout par celle de 1890, qui a étudié cette question avec toute la compétence voulue, et dont les rappôrts favorables ont été publiés et sont connus de tous.

Maintenant je donne ci-joint une liste (1) des personnes sur le patriotisme desquelles on pourrait probablement compter pour accepter la mission d'achever le Canal. Je crois que presque toutes sont plus ou moins connues des porteurs de Panama, qui les accueilleraient bien volontiers, sachant qu'avec leur appui la réussite de l'entreprise est presque assurée d'avance :

Comité de Direction

A Paris : MM. Christophle.
» Boucard.
» Monchicourt.
» Marinoni.
» Ménier.
» Beaulieu.
A Panama : MM. Wyse Bonaparte.
» Reclus.
» Sautereau.
» Thiébaud.
» Sosa.

Aussitôt la nouvelle Compagnie formée, un délégué serait envoyé près du Gouvernement colombien, avec pleins pouvoirs pour traiter avec ledit Gouvernement, et essayer d'obtenir qu'un ou plusieurs articles additionnels soient ajoutés au traité passé entre M. Napoléon Wyse Bonaparte, et ledit Gouvernement colombien, articles parlesquels ce Gouvernement renoncerait aux 14 millions de francs demandés à la nouvelle Compagnie, comme compensation et subsides militaires, selon contrat passé avec M. Wyse, Représentant de la liquidation de l'ancienne Compagnie, et accorderait à la nouvelle Compagnie tout le temps nécessaire, disons vingt années, pour terminer les travaux.

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(1) Cette liste, préparée par l'auteur, peut être modifiée selon les désirs de la majorité des porteurs de Panama.

Ce dernier article est très important pour que la Compagnie ne soit pas obligée d'accepter les contrats onéreux de certains Entrepreneurs, ce qui serait presque inévitable, si une date fixe reste stipulée. Comme compensation, on accorderait au Gouvernement colombien un tant pour 100 sur les bénéfices du Canal, et 10,000 actions de 500 fr., libérées et rapportant le même intérêt que les Actions ordinaires, ce qui, à 3 pour 100, demanderait une somme de 3 millions 850,000 francs, pour payer les intérêts depuis janvier 1893 jusqu'à 1900.

Connaissant la loyauté chevaleresque des Colombiens et leur grand désir de voir se terminer le Canal, je ne doute pas que le Délégué de la nouvelle Compagnie, qui se trouve tout désigné, *M. Wyse Bonaparte*, ne réussisse dans la mission qui lui serait confiée.

Ce premier projet est celui que je considère comme le meilleur, parce qu'il permettrait de reprendre les travaux immédiatement après la formation de la nouvelle Compagnie, ce qui assurerait l'ouverture du Canal pour le 1ᵉʳ janvier 1900, et aussi parce que le défrichement et la culture des 110.000 hectares de terrains en café, cacao, maïs, etc., dont il est parlé dans le second projet, seront peut-être d'une exécution difficile.

Je ne crois pas qu'il existe actuellement des plantations d'une aussi grande importance, sur lesquelles on puisse se guider avec certitude.

DEUXIÈME PROJET

PROJET DE SOUSCRIPTION (1)

POUR

LA FORMATION D'UNE COMPAGNIE ANONYME

SOUS LE NOM DE

COMPAGNIE DE PANAMA

Pour l'Exploitation industrielle des terrains concédés à la Compagnie du Canal Intérocéanique de Panama par le Gouvernement de la Colombie.

CAPITAL : CENT MILLONS DE FRANCS, divisé en quatre millions d'actions de 25 francs.

Payables comme il suit : 5 francs en souscrivant, 5 francs à la répartition, et le restant à raison de 5 francs par appel de fonds à des intervalles de deux mois au moins. •

Chaque action et obligation de Panama a droit à une action de la Compagnie de Panama aux conditions énumérées ci-dessus, à raison d'une action par chaque action ou obligation de Panama.

---

(1) Souscription exclusivement réservée aux porteurs de Panama.

Tout actionnaire ou obligataire qui n'aura pas souscrit au moment de l'émission, ou deux mois après, au plus tard. perdra tous ses droits, et les actions non placées seront offertes de préférence aux premiers souscripteurs.

Ainsi donc, avec **25 francs**, tout porteur d'une action ou d'une obligation de Panama se trouvera faire un bon placement, et contribuera à l'achèvement du Canal qui restera la propriété exclusive des anciens porteurs, lesquels rentreront à une époque peu éloignée dans la totalité des sommes placées en Panama.

Liste (1) du Comité de Direction :

MM. Boucard.
Wyse-Bonaparte.
Monchicourt.
Reclus.
Ménier.
Thiébaud.
Sosa.

BUREAUX A PARIS, RUE

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(1) Cette liste, préparée par l'auteur, peut être modifiée selon les désirs de la majorité des porteurs de Panama.

PROJET DE PROSPECTUS

Cette Compagnie est formée avec l'objet de développer la propriété de 500.000 hectares appartenant à la Compagnie du Canal interocéanique de Panama, dont 250,000 hectares actuellement dans les mains de la Compagnie et 250.000 hectares à recevoir du Gouvernement de la Colombie, aussitôt l'ouverture du Canal interocéanique ou avant.

La propriété de la Compagnie du Canal interocéanique de Panama a une grande valeur agricole. Ses terres sont très prolifiques pour la culture du cacao, café, canne à sucre, maïs, rïz, manioc, tabac, coton, indigo, vanille, bananes, oranges et autres fruits tropicaux, plantes médicinales, ramie, etc., etc.

Beaucoup de ces plantes produisent deux ou trois récoltes par an. La main-d'œuvre est à un prix raisonnable et peut s'obtenir avec facilité. Le transport dans l'isthme et au dehors est très facile et peu coûteux. Des lignes de steamers arrivent et partent constamment pour les Etats-Unis et pour l'Europe.

Aux Etats-Unis, en France et en Angleterre, il y a des demandes constantes de tous ces produits.

Même en se restreignant à la culture du café, cacao, tabac, maïs et bananes, on pourrait réaliser de grands bénéfices, comme il est démontré plus loin.

La propriété abonde aussi en essences forestières, telles que bois de cèdre, acajou, ébène, palmier, caoutchouc, etc., pour lesquels il y a une grande demande, même dans l'Isthme pour la construction de maisons, meubles, etc., et il n'y aurait besoin que d'installer quelques scieries pour pouvoir en tirer de grands profits, ce qui pourrait être fait à peu de frais, l'eau étant abondante sur la propriété.

On pourrait encore se faire d'autres sources de revenus en entreprenant l'élevage du bétail, de mules et de chevaux, pour lesquels il existe un grand débouché dans l'Isthme et les pays voisins.

Il s'y trouve aussi des mines d'or, de plomb argentifère, de mercure et autres minerais, avec lesquels on pourrait probablement tirer de grands revenus, si un jour ou l'autre on jugeait nécessaire de les exploiter.

Au prix de 2,500,000 francs, on peut mettre en culture pendant la première année, 5,000 hectares, plantés en produits de prompts rapports.

L'appréciation suivante, faite par des experts compétents, donnera une idée des profits réalisables immédiatement :

2000 hectares de maïs à 7 fr. 50 la charge ou 750 fr. par hectare	1.500.000 fr.
1000 hectares de cassave à 12 fr. 50 la charge ou 1240 f. par hectare	1.250.000 fr.
1000 hectares de bananes, 500 régimes à 60 cent ou 3000 francs par hectare	3.000.000 fr.
1000 hectares de haricots à 1000 fr. par hectare	1.000.000 fr.
Total :	6.750.000 fr.

fr. millions	6.750.000 00
Prix coûtant pour défricher, planter et cultiver 5 000 h. à 500 fr. par hectare	2.500.000 00
Bénéfice, millions, francs :	4.250.000 00

ou un peu plus de 4 p. 100 sur la totalité du capital souscrit. La seconde année, il est certain que les bénéfices seront au moins du double, 10,000 hectares pouvant facilement être mis en culture, ce qui donnerait un profit de 8 p. 100 du capital souscrit.

Dès la première année, avec une partie du capital souscrit, on commencerait de suite à défricher et à planter 100,000 hectares en cacao, café et arbres de caoutchouc, de façon à pouvoir faire la première récolte de café la troisième année. Cette récolte peut être estimée au bas mot à 25,000,000 de fr., soit 25 p. 100 en plus du 8 p. 100 acquis avec les 10,000 hectares plantés en maïs, bananes, haricots, etc., ou 37 p. 100 sur la totalité du capital souscrit.

La quatrième année, on peut compter sur un bénéfice de 50 millions de francs sur le café seul, ce qui, ajouté aux 8 p. 100 sur les plantations hâtives, nous donne 58 p. 100, auxquels il y aura peut-être à ajouter la première récolte de cacao, que l'on peut calculer, pour cette première année, à raison de 1,000 francs l'hectare, soit 100 millions ou 100 p. 100 sur la totalité du capital souscrit, en tout 158 p. 100.

La cinquième année, la récolte du cacao seul atteindrait la somme de 1,250 fr. par hectare, soit 125 millions de francs ou 125 p. 100, et chaque année successive elle augmenterait encore de 1,250 fr. par hectare jusqu'au jour où l'on arriverait à lui faire produire tout ce que ces sortes de plantations peuvent produire, c'est-à-dire 5,000 francs par hectare ou 500 millions pour 100,000 hectares.

Le revenu des plantations de café augmenterait aussi dans les mêmes proportions jusqu'à la cinquième année. A cette époque, il rendrait 75,000 francs par hectare ou 75 millions pour 100,000 hectares.

Je ne tiendrai pas compte de la somme considérable produite par le cacao, parce qu'il sera peut-être difficile de pouvoir exploiter en même temps 100,000 hectares de café et

00,000 hectares de cacao. Je m'en tiendrai donc au café seul.

Dans ce cas, on peut calculer que pour la cinquième année le revenu sera de :

Pour 10,000 hectares plantés en maïs, haricots, bananes, etc., 8 millions en chiffres ronds ou 8 p. 100	8.000.000 fr
Pour 100.000 hectares plantés en café ou 75 0/0	75.000.000 fr
Total :	~~78~~.000.000 fr 83

ou ~~78~~ 83 p. 100 sur la totalité du capital souscrit.

Et il n'y a aucune raison de prévoir une diminution pour les années successives, parce que l'on pourrait toujours faire de nouvelles plantations pour remplacer les anciennes, de façon à toujours avoir 100,000 hectares en plein rapport.

Ces chiffres peuvent paraître exorbitants, mais il n'en est rien. Ce sont des estimations faites par des gens du métier, deux professeurs distingués, MM. Rossignon et Morris, le premier pour le café, le second pour le cacao.

Si, au lieu de café, cacao, maïs, haricots, bananes, etc., on préférait planter de la canne à sucre, du tabac, du riz ou de l'indigo, voici ce que ces autorités compétentes ont calculé :

100.000 hectares plantés	en canne à sucre	produiraient	250.000.000 fr
— — —	en tabac	—	300.000.000 fr
— — —	en riz	—	100.000.000 fr
— — —	en indigo	—	200.000.000 fr
— — —	en sagou	—	150.000.000 fr
— — —	en café	—	75.000.000 fr
— — —	en maïs	—	500.000.000 fr
— — —	en bananes	—	250.000.000 fr
— — —	en manioc	—	100.000.000 fr

Si l'on prend la moyenne du produit de ces diverses cultures, nous obtenons un revenu annuel de 2,075 francs par hectare, soit 207 millions 500,000 francs pour cent mille hectares.

Par conséquent, il n'existe pas de meilleure affaire industrielle à pouvoir offrir aux anciens porteurs de Panama, et le Promoteur de la Compagnie, et probablement avec lui tous les futurs Directeurs entreprendraient de la former et de la développer, sans aucune rémunération pour leurs travaux, jusqu'à ce qu'un dividende de 10 pour 100 ait été distribué aux actionnaires.

Après la première répartition de 10 pour 100 aux actionnaires, on demanderait à ceux-ci de voter une somme suffisante pour les Directeurs, et, avec le surplus des bénéfices en caisse, 10 pour 100 seraient attribués aux actionnaires, 10 pour 100 aux Directeurs et 80 pour 100 à la Compagnie interocéanique du Canal de Panama, à fonds perdu, pour que cette Compagnie puisse terminer les travaux du Canal.

En considération de ces remises d'espèces, à fonds perdu, la Compagnie interocéanique du canal de Panama céderait à la Compagnie de Panama, à titre gracieux et définitivement, deux cent cinquante mille hectares des terrains qui lui ont été concédés par le Gouvernement de la Colombie.

Lesdits terrains pourraient être choisis par la Compagnie de Panama, où et comme elle le jugerait à propos et selon ses besoins, en une ou plusieurs fois, à son choix.

Immédiatement après l'ouverture du Canal, il ne serait plus rien versé à la Compagnie interocéanique, et tous les bénéfices reviendraient de droit aux Actionnaires de la *Compagnie de Panama*, sauf les 10 pour 100 alloués aux Directeurs de cette Compagnie.

Si les anciens porteurs du Panama acceptent ce projet de préférence au premier, ils sont priés de se mettre de suite en rapport avec M. Boucard, le promoteur des deux projets, celui-ci se proposant de partir pour Chicago, au plus tard en septembre prochain, de façon à se rencontrer dans cette ville avec Son Excellence M. Raphaël Nunez, Président de la République de Colombie, pour conférer avec lui, et de là aller à Bogota, s'il est nécessaire, pour obtenir du Gouvernement de la Colombie une nouvelle prorogation de dix ans pour l'achèvement du Canal, pour ne pas être exposé à subir les exigences des entrepreneurs, comme il en a déjà été fait mention à la fin du premier projet.

Le promoteur de la Compagnie de Panama pense que les travaux pourraient être repris immédiatement, quoique lentement, après la formation de la COMPAGNIE DE PANAMA, avec les fonds existant dans les coffres de la liquidation, le revenu du chemin de fer de Panama, la vente des Obligations à lots non placées, et plus tard avec les fonds mis à la disposition de la Compagnie du Canal interocéanique par la *Compagnie de Panama,* qui, d'après l'auteur, seront déjà si considérables vers la troisième année d'exploitation, qu'il croit possible de terminer complètement les travaux avant la fin de 1899, de façon à faire l'ouverture officielle du Canal le 1er janvier 1900 ou avant.

Tous les efforts possibles seront faits par la Direction pour obtenir ce résultat et inaugurer le VINGTIÈME SIÈCLE par l'ouverture du Canal, cette gigantesque et merveilleuse œuvre d'art, qui ouvrira une nouvelle ère de prospérité et de grandeur non seulement à l'Amérique, mais au **monde entier**, et qui sera un digne hommage rendu aux mânes de l'immortel CHRISTOPHE COLOMB.

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Délégué à envoyer près le gouvernement de la Colombie pour obtenir une nouvelle prorogation de dix années pour l'achèvement du Canal, et le faire renoncer aux 14 millions demandés à la nouvelle Compagnie. . . . 2

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Ouverture probable du Canal le 1er janvier 1900. 3

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THE
AMERICAN ISTHMUS
AND THE
INTEROCEANIC CANAL.

By W. HENRY HUNTER, M. I. C. E.

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THE AMERICAN ISTHMUS AND THE INTER-OCEANIC CANAL.

By W. Henry Hunter.

THE case for the severance of the isthmus which unites the northern and southern American continents, and thus divides the Atlantic and Pacific oceans, is presented by a glance at a map of the western hemisphere, and, to the mind of one capable of discerning the trend of events in the days in which we live, is established by a study of the same map.

The Atlantic and Pacific form the two great highways of the planet. To them all others are subsidiary,—adjuncts, or in the relationship of attenuated extensions,—whatever their character, their dimensions, or their position. At the Central American isthmus these two great through routes, upon which the commerce of the world and the progress of the nations depend, are divided by a neck of land, which, at any rate on one of the proposed lines of severance, is but some forty miles in width—but five miles longer than the channel excavated by local enterprise for the Manchester ship canal.

If it were necessary to emphasize by any particular claim of special advantage, the general benefit to commerce which would most certainly follow the opening of the inter-oceanic canal, we would base that particular claim, not upon the shortening of the distances between the eastern and western sea-boards of the United States, or upon the political gain to accrue from the reduction of distance between the naval outfitting ports on the northern Atlantic and the Philippine islands,—though these results would be important,—but on the effect which would be produced upon the tropical districts of the west by the construction and working of the canal.

The accomplished author of "Social Evolution" has recently issued a short, but weighty, *brochure*,* in which he has dealt with the general question of the tropical regions,—with their enormous capacities of production, on the one hand, and with the present wretchedness of their condition, on the other hand. He justly describes that condition as "altogether deplorable." He says: "A blight seems to hang over the whole region. There are only two words which ade-

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* *The Control of the Tropics.* By Benjamin Kidd. New York. The Macmillan Co.

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quately represent the condition of the immense territories included—anarchy and bankruptcy"; and he suggests the removal of the blight by the substitution, for the anarchy, of strong and righteous government,—that is to say, government by the governing races of mankind, by the great civilising powers of the world.

Anything which will conduce to this will confer a benefit on mankind for which no adequate standard of measurement can be found. It will, in truth, do something to hasten the fulfilment of the poet's vision, when

> Through Orient seas, o'er Afric's plain,
> And Asian mountains borne,
> The vigour of the northern brain
> Shall nerve the world outworn.

No one can doubt that the construction of an international highway through the Central American isthmus will tend to improve administration in the American tropics, to the nerving of that "world outworn" by "the vigour of the northern brain"; for this reason, then, if for no other, the isthmus *must* be severed, and the international highway made.

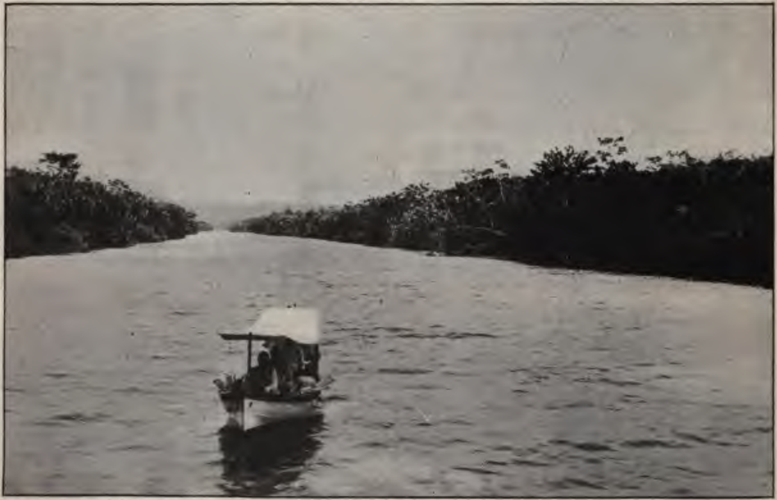
There are other reasons for the construction of this great junction of the seas,—reasons so many and so weighty that they have impressed men of perspicacity and enterprise for generations past, from Hernando Cortés to Ferdinand de Lesseps; men who were in advance of their time, men who saw clearly when other men were blind, men who agreed as to the necessity for the junction, but who differed as to the manner in which it should be effected.

Out of their differences arose the different schemes propounded from time to time: for a canal on the Darien line; for a canal on the Panama line; for a waterway (formed of junction canals at either extremity and of an existing inland sea) on the Nicaragua line; for a ship railway on the Tehuantepec line, which was the project of the late Captain Eads; and others of lesser importance.

Of these schemes but two survive,—the Panama canal and the Nicaragua waterway,—and their respective promoters and supporters struggle for the mastery.

As is usual in such case, all manner of side issues are being raised in the struggle; herrings are being trailed across the track, and considerations, some of them very unworthy, having no real bearing upon the point at issue (which ought to be simply the determination of the best and most appropriate method of achieving the desired purpose), are being dragged into the discussion by heated advocates and by indiscreet partisans.

Against this the minds and instincts of men of science must revolt. A scientific question of vast importance to humanity cannot be settled by appeals to international jealousies and racial hatreds. These are, alas! all too easily aroused. Political equilibrium is proverbially unstable, and mutterings about "control," once set going, soon serve their purpose of disturbing that unstable equilibrium. Then prejudice takes the place of argument, and rhetorical invective does duty instead of facts and figures.



THE FINISHED PORTION OF THE PANAMA CANAL, 10 MILES FROM COLON.
It is completely excavated to this width for 24 kilometers—14.9 miles.

We desire to avoid, in these pages, all extraneous questions, and to present, with such brevity as the circumstances will admit of, the salient features of the two rival routes, hoping that in this way we may be able to contribute to such a solution of the problem as will commend itself, by its loyalty to sound engineering and economic principles, to the minds of all competent and impartial judges.

THE PANAMA ROUTE.

It is to the credit of M. de Lesseps that he advanced further than any of his predecessors in title in promotion of the Panama canal, in that he made a determined effort to achieve that which they had but desired.

The effort ended in disaster; disaster which is now a matter of common notoriety, and of which the story has been told often and in terms so fittingly unsparing that the public mind has come to regard it as irretrievable, and, in some measure, to look with prejudiced eye upon any attempt to convert the disastrous failure into a meritorious success.

In 1888 M. de Lesseps's company collapsed. What is now known as *l'ancien compagnie* stopped payment, and, in accordance with the requirements of the French law, a searching and extended examination of its affairs and its administration was made by duly qualified legal officials.

The result was twofold. In the first place, there was a scandalous exposure of malfeasance, the like of which has not been seen since the days of the South Sea Bubble, followed by criminal proceedings in courts of competent jurisdiction. In the second place, the skilled and impartial officials to whom the examination was committed became possessed of two decided convictions: (1) that the Panama canal could be made and should be made; (2) that *l' ancien compagnie* had really done more toward the achievement of the waterway than it had at first been given credit for, and that the work which it had executed could be advantageously utilised in a renewed effort to effect the completion of the canal.

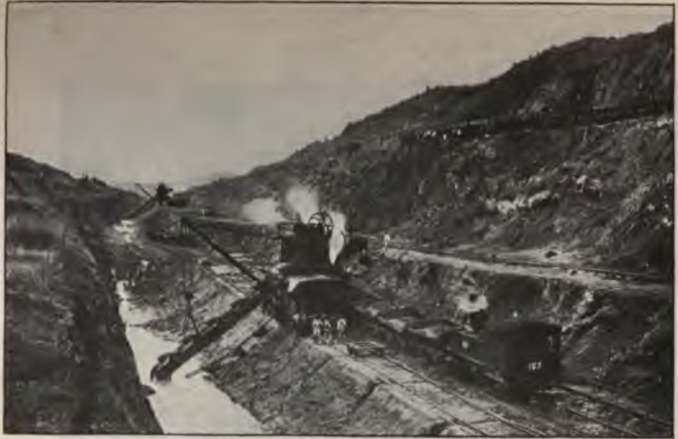
Impelled by these convictions, *les mandataires de justice* themselves took action, after several abortive attempts at reconstruction had shown the helplessness of the representatives of the old company.

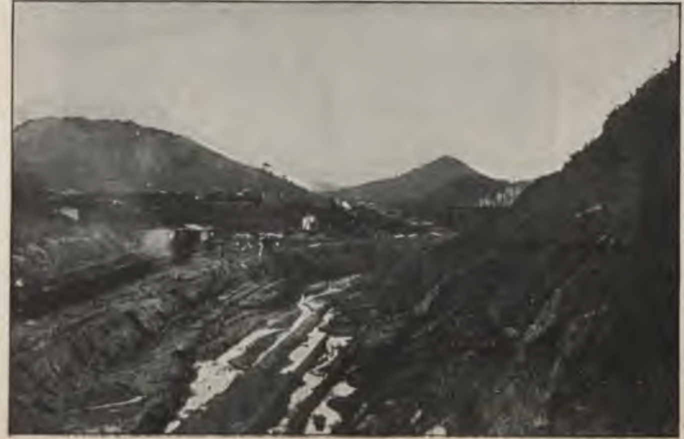
To appreciate the difficulties with which the liquidators were confronted at the time at which they intervened,—say, at the end of 1893,—it is necessary to recall one particular of their entangled environment.

The government of the republic of Colombia had granted to the old company a most valuable concession, by which that company was not only authorised to make the canal, but placed in possession of some 15,000 hectares of land upon the route of the canal, on which the company had erected workshops, stores, hospitals, administrative buildings, etc., at a prodigious cost; and upon which it had also collected masses of plants and materials.

It was necessary, if this great concession was to be preserved, that, on or before October 31, 1894, the works should be re-started *"d'une manière serieuse"*; there was to be no humbug about it.

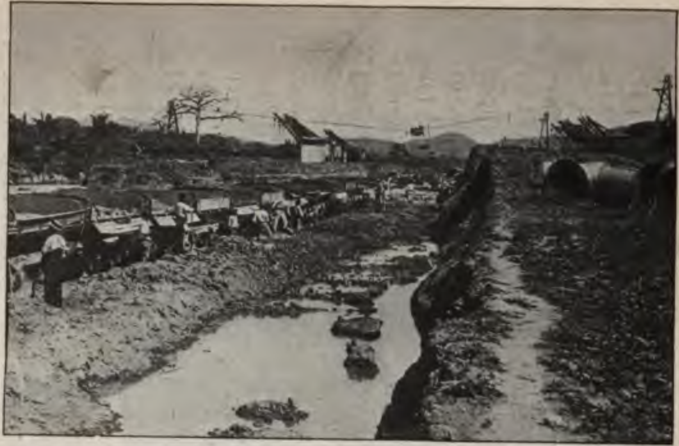
There was, therefore, but little time for carrying through the intricate arrangements which had to be made; but the liquidators faced the situation with stout hearts and hopeful spirits. They

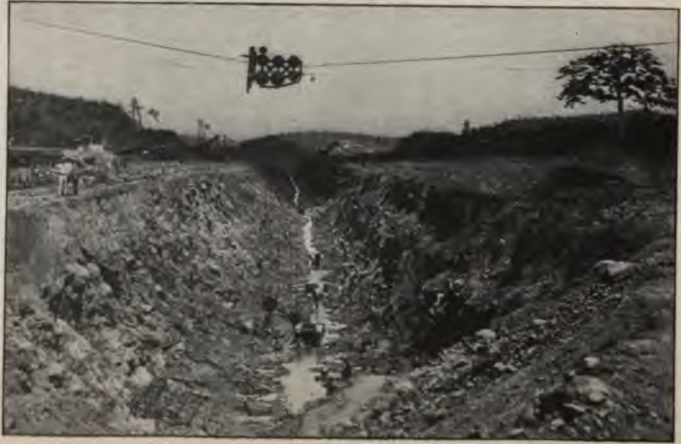




EXCAVATORS AT WORK IN A CUT.

THE PARTIALLY-COMPLETED CANAL AND THE PANAMA RAILROAD.





THE CANAL AT EMPERADOR. AMERICAN CABLEWAYS AT WORK.

THE CANAL 32 MILES FROM THE ATLANTIC, LOOKING TOWARD COLON.

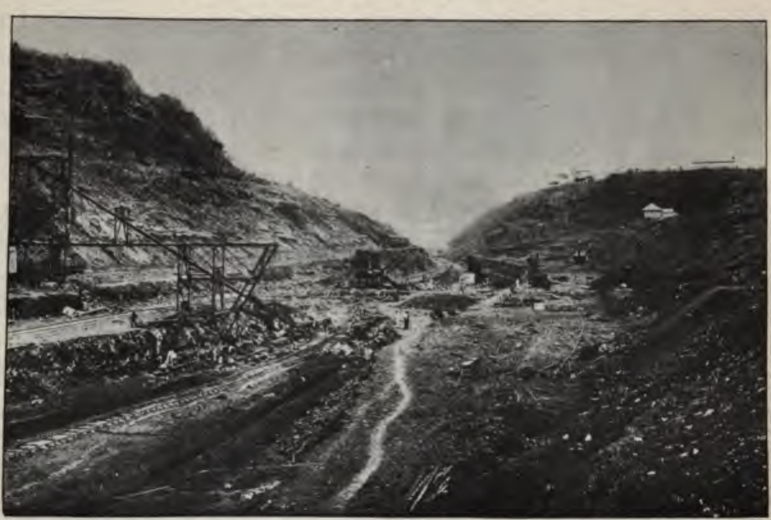
entered into negotiations with some of the great financial houses in France, and secured their powerful support. They also made representations of an effective character to certain of the persons who had profited by transactions with the old company, and informed those persons that, in the judgment of the liquidators, it was desirable, in their own interest, that they should subscribe the funds required for the re-opening of the works in the isthmus. Further, they obtained special powers from the French legislature, and finally they established upon a firm and substantial basis "La Compagnie Nouvelle du Canal de Panama," with a capital of 65,000,000 francs, or about £2,600,000.

The new company was definitely formed on October 20, 1894, just eleven days before the date on which the concession would have lapsed. The margin was very small, but it was enough; for vigorous measures were taken, the concession was saved, and the directors of the new company set about the discharge of the duties which they had undertaken. These were: (1) to preserve the concession; (2) to prove experimentally whether the construction of the canal was feasible; (3) if shown to be feasible, to prepare a project for construction, which would command the confidence of impartial men in the engineering, financial, and commercial world.

Some indication of the manner in which the duties have been discharged is afforded by the following particulars:

(1) In 1895, the company employed 3,000 men, and 370,000 cubic metres of material were removed; in 1896, the figures rose to 4,000

SITE OF THE BOHIO LOCK. CUT OF 160.7 FEET.



THE CULEBRA CUT. THE GROUND ORIGINALLY EXTENDED FROM ABOVE THE CREST ON THE LEFT TO THE HOUSE ON THE RIGHT-HAND BANK.

men and 700,000 cubic metres; and, in 1897, to 3,600 men and 960,000 cubic metres. Thus the terms upon which the concession was originally granted have been complied with, and work of substantial and permanent value has been carried out. Some idea of its extent may be gathered from the accompanying engravings, made from photographs taken on the spot.

(2) It was felt that three special difficulties, inherent and peculiar, confronted any would-be constructors of the Panama canal.

(*a*) The regulation of the river Chagres, a capricious tropical stream, flowing from east to west, discharging into the Caribbean sea to the westward of Colon; now winding its way in gentle stillness to the ocean, anon breaking out into torrential turbulence and foaming down its valleys in fierce floods for days together. This unbridled water course formerly cut the line of the canal at a dozen different points, presenting an obstruction at each. To avoid these obstructions extensive river diversions have been formed, through which the river now flows, and which have proved effective at all times except those of heavy floods. To provide for these much more extensive works will be required.

(*b*) The cutting through the Cordilleras, which, on the line of the canal, form the "divide" between the watersheds of the Atlantic and the Pacific.

Great uncertainty existed as to the character of the material to be excavated, particularly in the two heights, which stand in proximity to each other, to the southward of the centre of the isthmus; the more northerly height being known as Emperador, and the southerly (and greater of the two) as Culebra. To determine the real nature of the material, the directors decided to drive a "*cunette preparatoire*" through the peaks Emperador and Culebra.

THE CANAL AT SAN PABLO, 23 MILES FROM THF ATLANTIC.

In modern surgery, when uncertainty is felt as to the diagnosis of some internal trouble in a patient, the surgeon is as likely as not to proceed to make what he euphemistically describes as an "exploratory incision," which means that he cuts into the living man, in order to ascertain with precision what the nature of the sufferer's malady is.

The *cunette preparatoire* was an "exploratory incision" made in clay and schist and rock instead of in the living fibres of a human body; and the result of its execution (taken in conjunction with the results of numerous borings which were made and of trial bits which were sunk) was to demonstrate in an unquestionable way that the strata through which the canal cuttings will pass are of such a nature as to relieve the promotors from all fear of disastrous slips or landslides, either during or after construction.

(*c*) The climatic conditions under which the work must be undertaken, and the lack of efficient sanitation.

It is commonly reported that, in the course of the construction of the Panama railroad, which was carried out by an American company, and of which the route is nearly identical with that of the proposed canal, the laying of a sleeper or tie and the burying of a Chinaman were operations which were conducted concurrently by the constructing company. There is much of picturesque exaggeration about the statement, but undoubtedly the mortality was very heavy in those days, as it was also in the days of the old canal company.

The past, therefore, has been unfortunate; it is also irretrievable. But, learning from past failures, the new company proceeded on lines different from those followed by its predecessors. Drainage works were undertaken; sanitary regulations were enforced; the health of the employees was watched over; efforts were made to confine the immigration of workers to persons whose constitution and habits of life fitted them for residence and labour in the tropics.

The effect of all this, taken in conjunction with the works executed, has been an almost sensational degree of success. The route has been opened throughout its entire extent by means of the partially-completed cuttings; the trees and jungle-like undergrowth have been cleared from the line; thus an air channel has been formed, in which deadly stagnation has been replaced by revivifying currents, which pass as fresh breezes from sea to sea.

CANAL EXCAVATION AT LA COROSITA, 28 MILES FROM THE ATLANTIC.

It has been proved by trial that coloured labourers can work all the year round in the isthmus; that, of the number employed, at least 97 per cent. may be expected to be at work in perfect health at one time; that yellow fever and the other dread ailments of tropical swamps are not indigenous to Panama; and that, with ordinary care, Europeans may live there for years together without experiencing, by the fact of such residence, any serious increase of the peril of death in which all men always stand.

The directors of the new company may, therefore, justly claim that they have fulfilled the following functions: (1) preserving the concession; (2) demonstrating the practicability of the construction of the canal; (3) coping with the climatic conditions of the isthmus.

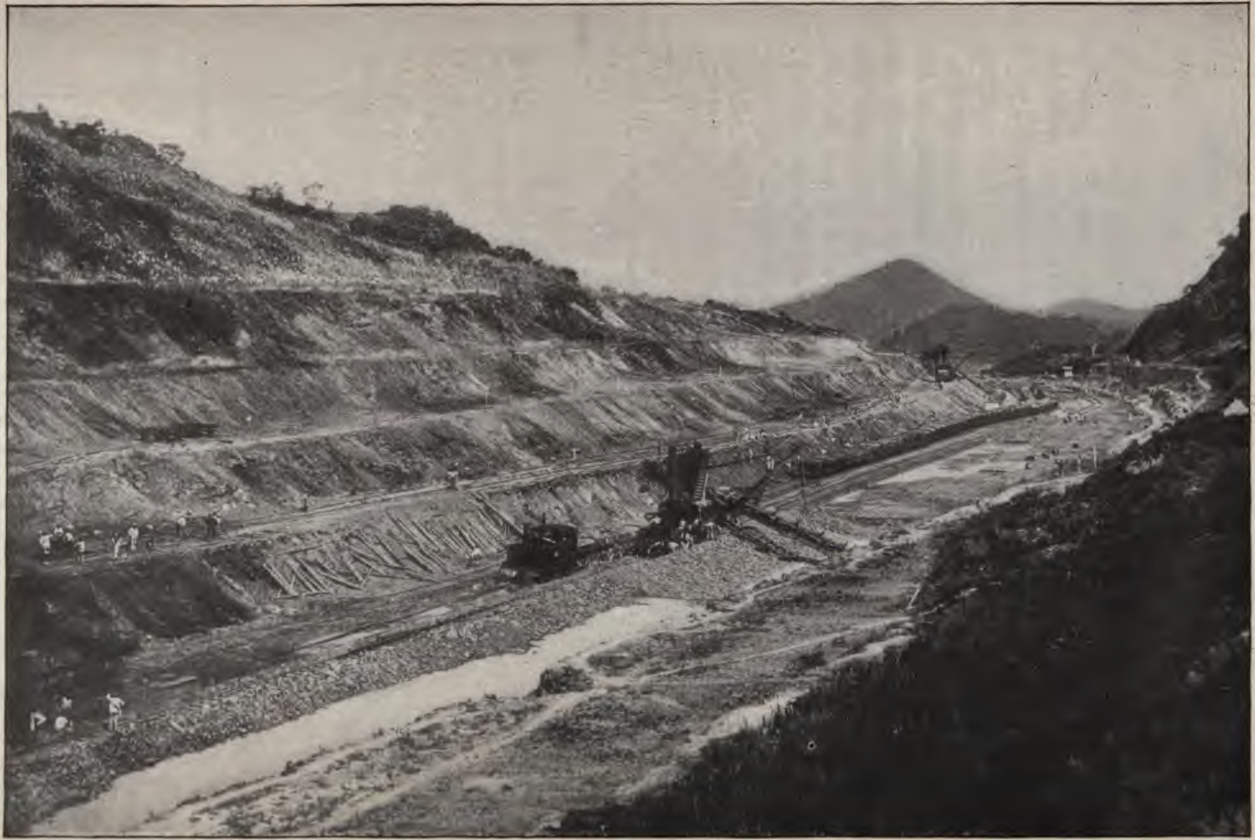
But a further duty devolved upon them,—*viz.*, that of preparing a project for the completion of the canal as a permanent work and as a navigable waterway,—a project which would, despite the previous failures of the old company, command the confidence and enlist the sympathies of competent men of all nationalities.

THE CANAL 33 MILES FROM THE ATLANTIC. FRENCH EXCAVATORS LOADING CARS.

In the discharge of this duty they obtained the best engineering advice available, and formed a competent engineering staff. In addition to this, acting under special legislative enactment, they summoned to their aid a number of outside engineering experts,—French, German, Russian, American, and English: all of them men holding, or having held, responsible positions, impartial in judgment, and possessed of such experience as to render each man specially fitted to advise on the proposed design and method of construction.

In this way the *Comite Technique* was formed.

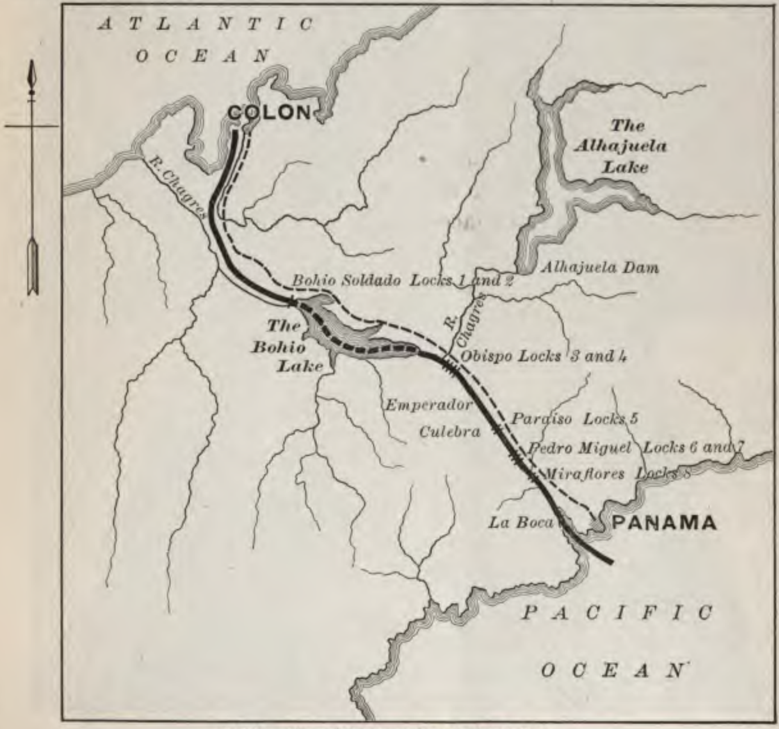
The *Comite Technique* was no merely ornamental appanage; the position of its members was by no means of an honorary sort. In



THE GREAT CULEBRA CUT, 34 MILES FROM THE ATLANTIC, SEPTEMBER, 1897. LOOKING SOUTHWARD conjunction with the directors and the leading officers of the company, it held nearly one hundred protracted sittings between the beginning of 1896 and the end of 1898, at which the whole of the main lines of the project were considered in closest detail.

As an example of the conscientious and painstaking way in which the members of this joint board discharged their duties, it may be noted that no less than sixteen different proposals for the arrangement of the longitudinal section of the canal were discussed by the board, and the pros and cons of each weighed, before a final decision was arrived at, troublesome and laborious though the process was.

Thoroughness characterised the whole of the proceedings of the board; nothing was left to chance; everything was, as far as possible, ascertained. Under the direction of the *Comite Technique* the whole of the route of the canal and of its collateral works was accurately surveyed and contoured; borings were made, trial pits sunk, streams large and small, (including the wayward Chagres) gauged, meterological observations made and recorded, and generally a mass of facts



NOTE. Line of Panama Canal shown thus ▬

FIG. 1. PLAN OF THE PANAMA CANAL.

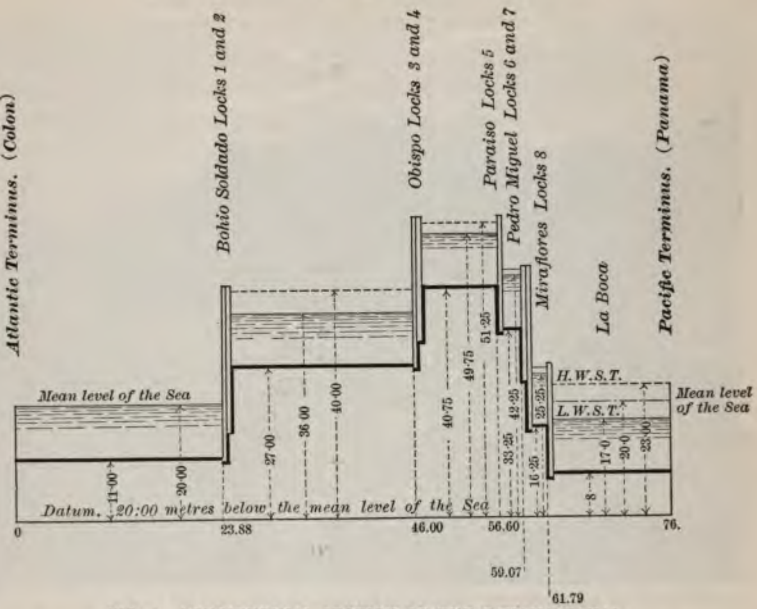


FIG. 2 LONGITUDINAL SECTION OF THE PANAMA CANAL.

This section shows the "Mean-Level Dividing-Lock System"; two other plans were considered by the *Comité Technique*—the High-Level, with the bottom of the summit level 29.75 metres above sea and the Low-Level, with the bottom of the summit level only 9.75 metres above sea. The canal, on the present line, can be brought down to sea level whenever the conditions warrant the expense.

accumulated through which the *Comite* was enabled to agree upon a project for the completion of the Panama canal, with which the new company is prepared to face—indeed, to invite—the criticism of the world.

The project, thus elaborated, is indicated on the plan (Fig. 1) and longitudinal section (Fig. 2) shewn on this page and the page opposite. The necessarily minute scales of the plan and section forbid the introduction of any detail; it is hoped, however, that the following brief descriptions will make the little drawings clear to non-technical as well as technical readers.

The termini of the canal are Colon on the Atlantic coast, and Panama on the Pacific. A line joining these two points would run, approximately, north-west and south-east. The distance between them is 42 miles, measured as the crow flies, and 46½ miles, measured on the line of the canal.

The canal is to be divided into six reaches; a maritime channel is to be formed on either sea-coast, and these channels are to be connected by four intermediate ponds of varying lengths.

EXCAVATOR AT WORK AT THE EXTREME WESTERN END OF THE CULEBRA CUT.

The channel on the Atlantic coast covers nearly one-third of the length of the canal, being itself 24.20 kilometres in length. The bottom width of the channel will be 30 metres, and the depth below the mean level of the sea (which is here practically tideless) will be 9 metres. The Atlantic channel (which is already completed, requiring but comparatively small quantities of dredging to give the full width and depth) will terminate on the flank of a hill at Bohio Soldado, where the first group of locks will be formed. The Chagres passes near to the site, the valley in which the river-bed lies being comparatively narrow at the place, confined as it is by high ground on either side. Advantage has been taken of this natural formation, in the design of the canal works.

It is intended that the valley of the Chagres shall be closed by a great embankment of earthworks, so constructed as to form a water-tight dam. By this means a vast lake will be formed behind the Bohio locks, the effect of which in the regulation of floods will be considered later. As an adjunct to the dam, a channel for the discharge of flood waters, which will be controlled by sluices of the Stoney type, will be constructed at Bohio.

The second reach of the canal will extend from Bohio to Obispo (a length of little more than 22 kilometres), and will, for the most part, be formed through the great Bohio lake, the width at the bottom being 50 metres, and the height above the mean level of the sea 7 metres. At Obispo a second group of locks is to be constructed, and at this point the summit-level of the canal will be attained, the reach from Obispo to Pariso, where a single group of locks is to be built, forming the "divide" of the canal, or, as the French say, *le bief de partage*. The length of the dividing reach will be 10.65 kilos, the bottom width 36 metres, and the height 20.75 metres above the mean level of the sea.

Then will follow two short ponds from Paraiso to Pedromiguel, and from Pedromiguel to Miraflorés. A double group of locks will be built at Pedromiguel, and a single group at Miraflorés, the respective lengths between the locks being 2.50 and 2.70 and the respective levels at the bottom of the ponds being 13.25 metres above and 3.75 metres below, the mean level of the sea, the width at bottom being 30 metres in each case.

At Miraflorés the level of the Pacific will be reached. The Pacific channel will be 12.70 kilos in length, divided into two parts, of which the first will extend from Miraflorés to the port of la Boca, and the second from la Boca to the terminus in the ocean. The width of the first part at the bottom will be 30 metres, and of the second 50 metres, the level of the bottom being 12 metres below the mean level of the sea, a tidal range of about 6 metres being experienced in the gulf of Panama at spring tides.

It will be noted that, in the foregoing description, the levels given, have, in all cases, been of the bottoms of the intended chan-

THE WESTERN END OF THE CULEBRA CUT.

nels and ponds. A minimum depth of water of 9 metres will be maintained throughout, but provision will be made which will permit of a considerable increase of the depths in the various ponds during times of flood, while at high water of spring tides the depth in the Pacific channel will be increased to 15 metres.

In the design of the canal, of which the leading features have been thus indicated, the answer to the crucial questions (1) as to the alimentation of the "divide" and (2) as to the regulation of the floods of the Chagres have been answered in a proposal as bold as it is free from complexity, and, so far as can be foreseen, as certain to be effectual as any engineering effort to control the forces of nature can well be.

The detailed surveys of the upper valleys of the Chagres brought into prominence the fact that, at a place bearing the uncouth appellation of Alhajuela, and lying about 16 kilos to the north-eastward of the lines of the canal, the river flows through a rocky gorge which forms a constriction of such sort as almost to lead one to regard it as a special provision of nature for the assistance of her sons in their effort to control some of her more turbulent forces.

OUTLET OF THE CULEBRA CUT ON THE PACIFIC SLOPE.

In this rocky gorge, on the rock of which it is formed, and of the rock by which it is surrounded, it is proposed to construct a great dam, after the style and character of that built by Mr. Fteley as a part of his magnificent works for the water-supply of New York.

The proposed dam will be about 286 metres in length, measured along its crest, and about 50 metres in height, measured from foundation to summit at the deepest part of the valley.

Behind this dam a second great lake will be formed, in which the minimum level of the water will be 58 metres and the maximum level 67 metres, thus furnishing a vast capacity for the storage of flood waters, which can in this way be impounded and employed as required for the feeding of the canal.

Between the dam and the line of the canal a *rigole d'alimentation*, or feed-water conduit, will be formed along the flank of the high ground on the left bank of the river; this conduit will be similar in many respects to the "flumes" of California, and will serve the same purpose as they do and in the same manner, but on a larger scale.

It is unnecessary to cumber this review with descriptive particulars of the manner in which it is proposed that the different works shall be executed, and of the progressive steps to be taken and stages to be reached, season after season, year after year. All this has been elaborated thoroughly and in patient detail, but need not be dwelt upon here. Neither is it necessary that we should attempt to epitomise the volumes of calculations which have been made of the flow of the Chagres, whether in respect to the whispering trickle of its stream in times of extreme drought, or the roar of its turbulent torrent in times of greatest flood. Figures without explanation are misleading, and, even with explanation, form but dry and uninteresting reading, except to statisticians—a limited class; and we confess to a desire to make this review serviceable to the largest possible number of readers, seeing that the matter of which we treat is one of profound importance for humanity at large, and of importance not only for the present day and for the present generation, but for days yet in the future and for generations yet unborn.

By the aid of the regulating works already described, it will be possible to work the canal in perfect safety at all times, and to hold even the greatest floods under perfect control.

Ordinary freshets and floods of small degree will be stored in the Alhajuela lake alone, whence their waters will be allowed to flow through the conduit, and in such quantities as the traffic may require, to the "divide" of the canal. Careful calculations have shown that a sufficient quantity of water can be impounded in the lake and between the planes of maximum and minimum water to feed the canal for more than twelve months, even if a single drop of rain did not fall within the limits of that period. It may be safely said that no such drought has taken place in Central America since men appeared on this planet, nor will take place until the day comes when the planet's "elements shall melt with fervent heat."

The construction of the Alhajuela dam will therefore provide for the alimentation of the canal at all times, and for the regulation of ordinary floods.

For the great and exceptional floods the storage capacity of the Alhujuela lake will be supplemented by that of the lake at Bohio. Provision has been made for raising the level of the Bohio lake by 4 metres. Special arrangements have been devised whereby the surplus water from Alhajuela may pass down the old course of the Chagres, through the dividing reach, and thus flow into the Bohio lake, whence they will be allowed to pass on their way to the ocean through the various river diversions in such volumes and over such times as the engineers in charge of the working of the canal may determine.

Given accurate data to work upon, the results arrived at by hydraulic calculations are absolutely certain and reliable. Such calculation show* that a steamer will be able to pass from end to end of the Panama canal at the height of the tropical rainy season and at a time when the Chagres, if left to its own devices, would have been boiling down in tempestuous flood, without finding a current at any point, either with or against her course, of more than two miles per hour.

The promotors of the Panama canal therefore claim, and, it must be admitted, with some reason, that in their project the bogie of the Chagres floods has been effectually laid.

But little is required to complete this brief description of the outlines of their project. The route has been judiciously selected, and the line carefully laid out. More than half the total length is absolutely straight on the plan, and for the remaining portion the curves are so easy as to be practically negligible from the point of view of navigation. It will have been noted from the description already given, and will be seen in Fig. 2, that there will be eight sets of locks in all, four on either watershed. The locks will in every case be constructed in pairs, a larger lock and a smaller lock lying side by side. The dimensions of the larger lock will be 225 metres (working length) by 25 metres, with central depth of 10 metres; of the smaller locks, 225 metres by 18 metres by 10 metres. It is proposed to equip the smaller locks with intermediate gates. Approach basins will be formed above and below the locks, and the mid-feather, or pier, separating the adjoining lock chambers will in each case be prolonged into these basins, so as to form a jetty for the guidance of vessels.

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* In the desire for the entire elimination of the personal element from these articles, allusions to the names of individuals have been avoided. Competent critics, both in England and America, will, however, accept the results of these calculations more willingly if we add here the statement, that the calculations throughout have been made by General H. L. Abbot, late of the United States corps of engineers.

Taking into account the value of the work already executed, and pricing the work yet required at the rates at which the comparatively small works of the last three years have been carried out by the new company in the isthmus of Panama, it is estimated that the canal can be completed, equipped, and opened for traffic at a cost of £20,000,000 sterling, or $100,000,000, including the cost of administration as well as interest paid out of capital during the period of construction.

The time required for completion, if all things go well from first to last, and if serious *contretemps* do not arise, will be about eight years. So uniform good fortune, however, does not often fall to the lot of constructors of public works; it is therefore proposed to add 25 per cent. for contingencies, making the estimate of time required for completion ten years; *i. e.*, if the constructible work is proceeded with vigorously from the present time, the Panama canal will certainly be opened to the traffic of the world on New Year's Day, 1909.

A REVIEW OF THE NICARAGUA CANAL SCHEME.

By W. Henry Hunter.

THE project for the construction of a maritime canal on the Nicaraguan line resembles its rival of Panama, in that it is the modern outcome of a lengthened history.

The years 1850-52 form an important landmark in the narrative, for in those years, and at the instance of the Transit Company (in whose hands the whole of the trans-isthmian trade—such as it was—then lay), Col. O. M. Childs, a canal engineer of special ability and experience, made the first engineering survey of the Nicaragua route ever executed, which, although necessarily meagre and imcomplete, has formed the basis of all which has since been done in connection with that route.*

Col. Childs submitted a report and a proposal for a waterway with a ruling depth of seventeen feet, which appears, so far as it went, to have been of a workmanlike character, and suitable for the requirements of fifty years ago, the weakness in the scheme being due to the inefficient design of the harbour at Brito, which formed the Pacific terminus of the undertaking. This weakness was, in some degree, recognised by Childs himself, who, with refreshing *naïveté*, deprecated criticism of the design, on the ground that he was a canal engineer, and inexperienced in the construction of harbours. A much more serious weakness, then latent, since developed, lay in the decaying condition of the Atlantic terminus, the harbour at Greytown, which, in Childs's time, was still commodious and convenient, but in which, since his time, deterioration has ended in destruction.

The year 1872 furnished the next stage in the story, when the United States government despatched a party under the charge of Commander Lull, U. S. N., to examine further the route proposed by

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* The Editors hoped to present, with this paper, a series of illustrations which should show the progress of work on the Nicaragua Canal as accurately as the progress of the Panama enterprise was exhibited, by photo-engravings, last month.

Two fatal obstacles were interposed. First the actual work done, as summed up by Mr. Hunter on the opposite page, is too small to supply many subjects for illustration of canal construction; second, the Maritime Canal Company decline to supply any photographs except for use in connection with an article which has their approval. Mr. Hunter's view point, being the same as that of the Ludlow commission, is not pleasing to them. The photographs presented show the general topography of the country traversed.

Col. Childs, and to obtain, in addition, such information, topographical, physical, etc., as was practicable in the time at the disposal of the expedition. Commander Lull presented his report in December, 1873. He recommended that the Childs project be enlarged, that the ruling depth of the canal be increased to twenty-six feet, that the locks be made longer and wider, and that certain modification be made in the positions of the locks and dams.

Among the gentlemen who formed the Lull expedition was Mr. A. G. Menocal, who had just entered the government service as a civil engineer attached to the United States navy. Under the direction of the government Mr. Menocal revisited Nicaragua in 1880, and again in 1885, carrying out at each visit further geodetical operations and reporting to the government in 1885. Mr. Menocal suggested important modifications in the Childs project as amended by Lull, which, with others introduced from time to time since the date of the report, are practically all embodied in the scheme now presented by the Nicaragua Canal Company; it is, therefore, unnecessary to describe or discuss them at this point.

Shortly after the publication of Mr. Menocal's report, and through his agency, a concession was obtained from the government of Nicaragua for a construction of a canal within the Nicaraguan territory, and on the line proposed by Mr. Menocal. The concession provided, *inter alia*, that the final plans of the canal should be deposited, and that the work should be begun in earnest, within a period of two and one-half years from the date of signature. The Nicaragua Canal Construction Company therefore was formed, the concession was transferred to it, some money was raised, and arrangements were made for the commencement of preliminary operations at the terminus of the canal on the Atlantic seaboard.

In 1889 the Maritime Canal Company was formed under a special charter from the United States legislature, and the concession was transferred once more,—this time from the Construction Company to the Maritime Company, arrangements being made, somewhat difficult for outsiders to follow, by which the work was still proceeded with by the Construction Company. That the arrangements were not without their advantages became apparent in 1893, for in that year theConstruction Company went into liquidation, leaving the position of the Maritime Company intact.

Since 1893 the financial situation has, in the words of the present president of the Construction Company, "been bad." It has been difficult to obtain money, and but little work has been executed, Prior to that date, a length of one thousand feet of pier-work had been constructed at Greytown, a channel had been dredged on the foreshore, and some three-quarters of a mile of the canal had been formed by dredging in the low, swampy ground. A single line of railway had also been formed across the lagoon, from Greytown to the site of the first lock, the length of the line being about eleven and one-half miles. These works, with the addition of certain telegraph lines, represent the sum total of the efforts which have been made to construct a waterway on the Nicaraguan line.

The project which the Construction Company thus commenced to carry out was one which was described in a report by Mr. Menocal, and which was submitted to the company in 1890. The report was adopted, and the project accepted by the company as its own.

Before describing the project in any detail, another important event in the history of the scheme should be noted. In 1895, following upon the passage through the legislature of an act to amend the Maritime Company's act of 1889, and under special statutory powers, a board of engineers was appointed by President Cleveland "for the purpose of ascertaining the feasibility, permanence, and cost of construction and completion of the Nicaragua Canal," as proposed by the company. The board was composed of three members, each of whom was a distinguished engineer of special experience and absolute impartiality, the names of the members being Col. Ludlow, U. S. A., Mr. Endicott, U. S. N., and Mr. Noble, a civil engineer specially experienced in canal construction.

These gentlemen spent six months in a careful study of the Canal Company's project, going over the route in Nicaragua and examining the drawings and documents in New York. They presented their report on October 31, 1895. The report was not regarded by the Canal Company as a satisfactory document, and, since its publication, the representatives of the company have met the conclusions arrived at and the recommendations made by criticisms couched in terms of such asperity as almost to border upon acrimony.

Notwithstanding these efforts (natural enough under the circumstances) to weaken the force of the report, it still remains the one authoritative pronouncement by an impartial tribunal upon the proposal of the Nicaragua Canal Company, or, to speak more accurately, it did remain as such until a very recent period, when the second commission appointed by the United States government, and presided over by Admiral Walker, presented a report which, from the abstract presented, seems to emphasize the value of the opinions expressed by Col. Ludlow* and his associates.

In the following effort to describe the Nicaragua Canal project as developed by the company, the views and recommendations of the Ludlow board will, so far as is practicable, be considered together with the details of the company's scheme.

The termini of the proposed waterway have been located, respectively, at San Juan del Norte, or Greytown, as it is more commonly called, on the Atlantic, and at Brito on the Pacific. A line joining these two points would lie but a few points off due east and west, the distance between them being about 140 miles as the crow flies. The same distance measured on the line of the waterway is given by the Canal Company as 169.4 miles, but even this elementary figure has been adversely criticised by the board, which considers it to be 4.5 miles too short, in which case the total length is about 174 miles.

PRIMITIVE NAVIGATION ON CENTRAL AMERICAN WATERS.

The special feature of the Nicaragua route is the great inland sea

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*The place occupied by Col. (now General) Ludlow in the confidence and esteem of his fellow-citizens may be gathered from the fact that he has recently been appointed to fill the difficult and responsible post of governor of Havana.

THE HARBOR AT PORT LIMON.

which lies in the hollow between the eastern and western Cordilleras, and which is known as Lake Nicaragua. It has a length of 110 miles, an average width of 40 miles, and an area of about 2,600 square miles, the mean level of the surface being 110 feet above the sea. This great lake divides the projected waterway into three sections, as follows:

1. From Greytown to the easterly side of the lake, 100.40 miles.
2. Across the lake, 56.50 miles.
3. From the easterly side of the lake to Brito, 17.25 miles.

The special feature of the company's scheme for the waterway, and that which differentiates it from its predecessors on the same line, is the proposal for the extension of the summit level—the level of Lake Nicaragua—both to the eastward and to the westward by the formation of two huge dams,—on the one hand, at Ochoa on the Rio San Juan, at a site below the confluence of the San Juan with its greatest tributary,—the San Carlos, and, on the other hand, at La Flor, in the basin of a small stream called the Rio Tola. The summit level would be so extended through the construction of these dams as to cover a length of about 149 miles out of the total length of 174 miles,—that is

VOLCANO OF MONOTOMBO, NEAR LAKE MANAGUA, NICARAGUA.

to say, a vessel passing through the Nicaragua Canal would traverse a section of nearly 150 miles in length without any lock.

Taking Greytown on the Caribbean sea as the starting-point of a description of the details of the company's scheme, the most formidable difficulty which lies in the way of the achievement and of the successful working of the project is met with at the very threshold. Greytown lies in a re-entrant angle formed by the delta of the San Juan, and on a lagoon which was once a harbour, the mouths of the river which form the present channels of discharge for its waters lying to the eastward and southward of the lagoon.

The reason for what, in the language of theology, would be termed the perversion of the harbour has been the subject of much discussion, although the leading physical features to which the perversion has been due, and as to which all are agreed, are fairly well defined. First, the San Juan drains an area of more than 15,000 square miles. The rainfall in the watershed is enormous, the maximum being on the Atlantic coast line, where it reaches the prodigious figure of three hundred inches per annum! From that coastline the rainfall diminishes sensibly in the direction of the Pacific, but is still extraordinarily great over the whole watershed. Then the basin of which Lake Nicaragua is the centre, and to which the San Juan furnishes the outlet, has been subjected for unknown ages to volcanic disturbance, and is still dotted over with cones and craters. This volcanic activity (now well-nigh outworn) furnished an unlimited supply of material for transport to the sea, while the rushing rivers, themselves the products of the torrential rainfall, furnished the transporting power required.

The swamps on the fringe of the Caribbean, through which the mouths of the San Juan have been formed, bear witness to the potency of these mighty volcanic and climatic forces, for, through their effects, the coast line has been thrust back from the low hills, whose feet were once laved by the ebbing and flowing tides, but which are now divided from the ocean by some ten or twelve miles of intervening land, swampy land, formed of the *debris* from the hills and the upland vallies, and from the igneous dust emitted by the sobbing craters and brought down by the burdened streams.

The distance between the hills and the coast line would have been greater than it is, but, as the river thrust the delta further and further into the sea, the coast winds, constantly varying in force, but within certain limits nearly steady in direction, have acted, and still do act, on the coast line, striking it at an angle, causing ceaseless wave action and consequent attrition, and re-disposing the eroded material along the coast in a more regular and even way than that in which it was first deposited.

As a result of all this, there is a constant trend of material towards the re-entrance angle in which Greytown is situated, with the further result that the one-time safe and commodious harbour was first shoaled and then obliterated, the fact being that the angle is being filled up, slowly, but surely.

The policy which fights against the forces of nature is a mistaken one; it is foredoomed to failure. Nature may be aided in her operations; her more gigantic forces may to some extent be curbed and controlled; but an almost certain Nemesis pursues any effort which may be made to arrest and to determine in an absolute way a process so continuous as that of the filling up of the Greytown bight.

Having in view the facts of the case as to Greytown, and having, after close investigation, arrived at the conclusion that the destruction of the harbour there *was* due to a continued effort of nature, the board recommended that the efforts which had been made to commence the construction of the canal at that point should be abandoned, and that the entrance should be moved some distance to the eastward. The recommendation has been met on the part of the representatives of the Canal Company by stout resistance, their principal objection being that the change would involve the transfer of the terminus from the territory of Nicaragua to that of the neighboring State of Costa Rica, and that the transfer would not be agreeable to the Nicaraguan government and might imperil the concession.

The word "government" is of elastic significance. It has one meaning when used in relation to a civilized and powerful State, and quite another when used in relation to an Isthmian republic.

Difficulties raised by a government of this class should not be insuperable, nor can objections based on the apprehension of such difficulties be regarded as weighty. Nevertheless the difficulties are maintained by the Canal Company; they decline to abandon their infant works at Greytown, and adhere to that point as the terminus of their scheme. No person who has had practical acquaintance with the difficulty of keeping open a navigable channel across a sandy foreshore will doubt that, if a channel of the required depth can ever be formed at Greytown, such channel would be filled up whenever strong winds from the east or northeast might prevail for any time, and silted up to such an extent as to effectively block the traffic (except perhaps in the case of small vessels of light draught) for weeks together, even in the face of the most desperate efforts, which would undoubtedly be put forth for its removal by a frantic administration.

A CENTRAL AMERICAN FOREST.

From Greytown the course of the canal will pass through low, swampy lands and stagnant lagoons, till the rising ground which is to form the site of the first lock is struck. The length, measured on the line of the canal, is already ten miles: it is not anticipated that any constructive difficulties will be encountered in this length. Lock No. 1 is to have a lift of 31 feet from mean sea-level; and, in conjunction with it, a series of small embankments are to be constructed, so as to close the gaps in the hills and form a basin above the lock. Through this basin a channel is to be carried to the second lock, the work required being merely excavation and dredging. Lock No. 2 is to be placed at a distance of 1.25 miles from Lock No. 1, and is to have a lift of 35 feet; a second basin is to be formed above Lock No. 2, with a channel of a length of 1.95 miles to the third lock. A heavy dam and another series of embankments will be required to impound the waters in the second basin. At Lock No. 3 the summit level—provided the anticipation of the promoters be realised—will be attained by a lift of 40 feet. It is necessary to insert the proviso, as a serious discrepancy exists between the anticipations of the advisers of the company and those of the board. Further reference will be made to this discrepancy. It is sufficient here to say that, in the view of the board, the lift at Lock No. 3 will be 44 feet.

A third basin is to be formed above Lock No. 3 by means of a third series of embankments. Through this basin the navigation will be carried for about three miles, where the spur of the Cordilleras, which forms the "eastern divide"—that between the Caribbean and Lake Nicaragua—will be reached. A favourable location for the line of the canal has been found through the spur; yet the cutting required will be of sufficiently formidable dimensions, as the length will be 2.90 miles, the maximum depth 328 feet, and the mean depth 141 feet.

The possibilities of disaster in a cut of these dimensions are almost infinite, and the most searching and complete investigation is required before even an approximate estimate of the cost of carrying it into execution can be made. The board complains that no such investigation has been made, and points out that the borings which the company did make showed "rock more or less decomposed" at great depths below the surface, "which may crush and cause the sounder rock above to fall." This ominous fact appears to have been overlooked or ignored by the company.

It is proposed that the bottom width of the canal in the cutting through the eastern divide should be reduced to 100 feet, the bottom width of the channels at either side being 120 feet. After leaving this cutting, the course of the canal is to be carried through four basins, which are to be formed in the San Francisco and adjoining valleys, and are to be connected by three cuttings of moderate depth, the aggregate length being 3.5 miles. A further series of dams and embankments, some of which will be huge, perilous, and costly work, will be required to enclose these basins.

It is claimed that* "several important advantages are gained by this treatment," the first being an obviously substantial saving in the cost of excavation. The claim proceeds: "The economy, however, is not confined to the saving in excavation, against which, of course, must be charged the cost of the embankments, but is principally in the enormous saving in the deep rock excavation following, and in the valley of the Deseado beyond, by carrying the summit level through into the valley of the stream. The increased cost to result from a plan contemplating a much lower level would have been so great as to seriously handicap the undertaking financially." It is further claimed that the gain in navigation facilities and in maintenance are important, and that the drainage operations will be assisted by the high-level scheme.

A SAMPLE OF RAILWAY CONSTRUCTION, SAN JOSÉ.

There is grave doubt as to whether the advantages to be gained by the treatment proposed are commensurate with the almost incalculable cost of the works, the risks of construction, and the uncertainties of maintenance, involved in the formation of dams 80 to 85 feet in height from the level of the ground, upon sites in which the borings revealed that a depth of thirty feet of soft mud must be passed through before anything in the nature of firm soil can be reached, and in a climate in which "rainfalls of nine inches in nine hours, and of three in a single hour," are experienced.

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*"The Nicaragua Canal," by A. G. Menocal. Paper read at the World's Water Congress, 1893.

The original intention was to form these dams to such a height as to enable their crests to be employed as waste weirs for drainage purposes. Had this intention been carried into practice, disaster would have been not only courted, but constrained. More prudent counsels have prevailed, however, and the present intention is that the dams should be raised above the highest water level, and that the drainage should be provided for by sluices, to be placed in the solid ground, at a low level, and adjacent to the site of each dam.

These sluices, together with other works, have been provided "to meet possible contingencies, specially in the series of embankments in the San Francisco ridge, which, it is frankly admitted, is the weakest feature in the whole route."*

At the westerly extremity of the uppermost of the three cuttings by which the basins in the San Francisco ridge are to be connected, the course of the river San Juan itself will be struck. It is intended that the course of the San Juan should be utilized for navigation for the whole distance between the uppermost cutting and Lake Nicaragua,—a length, according to the company, of 64.5 miles, or, according to the board's correction of the company's figures, 69 miles.

To permit of the utilization, the level of the San Juan, and of its great tributary, the San Carlos (the confluence of the two streams takes place at a point about four miles further up the course of the San Juan), must be raised to the level of Lake Nicaragua. In order to achieve this, the formation of another huge dam is projected, the location being at Ochoa in the San Juan valley. The design for this dam is said to have "been for years the subject of long study and careful consideration." Unfortunately the ground at the site which had been selected is of the most unfavourable character for the foundation of such a work, the central borings having been carried to a depth of twenty-five feet below the bottom of the river, without reaching any material more satisfactory than drift sand. The central borings were abandoned at the depth stated, so that the depth at which a solid foundation might be found is unknown; while the side borings—*i. e.*, those on the flanking hills—showed that thick beds of clay overlay the rock. Owing to the foundation difficulty, all idea of constructing a dam of the solid character usual in cases where consequences so momentous would follow a failure was abandoned, and a proposal which is considered "to embody simplicity, economy, and safety" was adopted. The proposal is to dump "from an aerial suspension conveyor large and small material properly assorted, across the river, from bank to bank, until a barrier is created sufficiently high and strong to arrest the flow and hold the waters at the desired level." It is not intended that the dam should be water-tight, it being assumed that the flow of the San Juan will, in the driest season, be ten times as great as the quantity of water which will be required for lockage and other traffic purposes, and consequently that 90 per cent. of the flow may be permitted to discharge itself *through the dam.* (The board entirely disagrees with the assumption as to the minimum flow of the San Juan.) It is further intended that, in addition to the use of the dam as a filter of a singularly coarse type, the crest thereof should be employed as a waste weir, discharging a considerable proportion of the immense floods of the San Juan.

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* Mr. Menocal's paper to the World's Water Congress.

A ROAD IN THE CENTRAL AMERICAN CORDILLERAS.

The principles of static resistance to dynamic stress are now fairly well understood in the engineering world. The application of these principles to the case of the proposed Ochoa dam has, briefly stated, the following results: (1) the frictional resistance to sliding or rolling, one over the other, of the component parts of the dam, is to be destroyed by invited percolation; (2) an impelling force of kinetic energy is to be induced to act upon the dam, in the manner in which that energy will be most effective; (3) an equation of the forces of resistance and destruction will be established, which will take the form of a somewhat extended line of *debris* over a considerable part of the valley of the San Juan. It is hardly necessary to add that the proposal has provoked almost unanimously adverse criticism, since it was first announced; yet it is gallantly maintained by its author. It is a modern instance of *Athanasius contra mundi.*

The company proposes that the crest of the dam should be formed at a level of 105 feet above the sea. It intends that the summit level of the lake shall be 110 feet, and, as it anticipates that a fall of three-fourths of an inch to the mile will be found to exist, even in dry seasons, over the whole surface of the San Juan for the 64½ miles (as

A NATIVE HOUSE, COSTA RICA.

VENGANZA BRIDGE, ATLANTIC RAILWAY.

they reckon the distance) which intervene between the lake and the site of the dam, it proposes to provide for the fall of 4 feet and for the overflow depth on the crest by lowering that crest 5 feet, thus arriving at the proposed level of 105 feet.

Herein is the discrepancy between the anticipations of the company and those of the board, to which reference has already been made. The board is of opinion (and most practical men will agree with them) that the dry-weather flow from the lake has been seriously over estimated, and that, in view of the true quantity of water passing and the great sectional area of the canalized river, the surface inclination of the river will be practically *nil*, as the river will become but a prolongation of the lake. This important question sensibly affects the estimates of the cost of construction.

But few words are required to describe the proposed course of the navigation between Ochoa and Lake Nicaragua, the work in rendering the San Juan, as raised and canalized, suitable for navigation purposes being of an ordinary character. No question of engineering practicability, either as to construction or maintenance, will arise. The questions are only as to cost and time. The company proposes that the bottom width of the channel shall be 125 feet, which appears to be sufficient, except at the curves; the board recommends 250 feet as the width.

The proposal for the formation of the channel across Lake Nicaragua also admits of great brevity of review. On the navigation line the lake measures about 56½ miles from side to side; to form the channel, some 14 miles of dredging through soft mud will be required on the westerly side, while on the easterly shore a rocky ledge of 400 yards in width will be met with, through which the course of the canal is to be carried by means of blasting and dredging. Two short protecting piers are also to be constructed at the easterly junction of canal and lake. The course of the canal will strike the lake at the point where the river San Juan flows out from the lake, and will leave the inland sea at the point of inflow of the river Lajas. The length of that course from the mouth of the Lajas to the Pacific terminus will be a little more than 17 miles; of this length some 9 miles, measured from the mouth of the Lajas, will be in continuous cutting, the "western divide" being reached at 4.70 miles from the commencement of the cutting. Even through the "divide" the depth of the cutting will be moderate,—73 feet,—the point of intersection being, in the words of the company, "the lowest in the mountain chain which extends from the Arctic ocean to the straits of Magellan." The excavation will be mainly in rock, and it is intended that through the deeper part the bottom width shall be 100 feet, the width on either side being 125 feet. The western extremity of the cutting will debouch upon the valley of the Rio Grande, which, with the adjoining valley of the Tola, is to be converted into a hugh basin by another great dam, to be formed at a place known as La Flor, where the fourth and fifth locks are also to be built. La Flor is about fourteen miles from the western shore of Lake Nicaragua, measured (like the other distances referred to in the foregoing) along the course of the canal.

Looked at upon the surface, the site of the proposed dam appears to be most favourable, as the valley is constricted and the flanking hills are high. Unfortunately the difficulty as to foundations, which is inherent to almost the whole of the route proposed for the canal, becomes particularly acute at La Flor. Borings made on the line of the dam showed that no less than 100 feet of very soft material would have to be passed through before the rock could be reached and a foundation obtained. Originally it was proposed that a "rock fill" dam, similar to that suggested for Ochoa, should be dumped in at

La Flor, but the design has been modified,—very prudently; and it is now intended that a solid core of concrete, founded upon the rock, shall be formed, and shall be reinforced by earthworks, on either side. Properly proportioned and executed in a workmanlike manner, this would form a satisfactory and reliable dam, and one upon which the safety of a great waterway might be allowed to depend; but it is desirable that the estimate of its cost should be made or revised by some person who has already caried out a similar work, while the manner of construction proposed for it throws the remarkable character of the design for Ochoa into even stronger relief.

A RAILROAD CUT IN EARTH AT LA JUNTA.
Showing the steep earth slopes.

Locks 4 and 5 will have a combined fall of 85 feet,—*i. e.*, from the summit level 110 feet to 25 feet above sea-level.

From these locks the course of the canal will traverse the valley of Brito, in which, and at a distance of 1.58 miles from Lock No. 5, Lock No. 6, the last on the route, is to be constructed. As the Pacific has a tidal rise of 8 feet at Brito, the fall at Lock No. 6 will be variable, 29 feet being the greatest fall and 21 feet the least. From this lock to the Pacific foreshore a channel of nearly a mile and a quarter in length will be formed; the work will be confronted by no special difficulties, and calls for no special remark here.

HEAVY GRADE ON THE FERRO CARRIL DE COSTA RICA.
Showing the steep earth banks.

In the paper which was presented to the Chicago Congress of 1893 by the chief engineer to the company—to which reference has already been made—it was stated that "the only well-founded criticism to the Nicaragua route of an inter-oceanic canal is the lack of good harbours." Strict literary accuracy might take exception to the statement, having regard to another statement in the same paper (quoted *in ante*) that "the series of embankments in the San Francisco ridge . . . is *the weakest feature in the whole route*" and might well argue that, if, in the case of the harbours (or want of harbours) where the weakness appears to be regarded as but comparatively great, criticism of the company's project is admitted to be "well founded," criticism of a feature whose weakness is the subject of superlative description may claim to have an even more substantial basis.

Be this as it may, there can be no doubt that the want of terminal harbours is the overwhelming difficulty which would have to be encountered, if a serious effort were made to construct and work the waterway on the Nicaragua line, as now proposed.

Brito is not as bad as Greytown, but Brito is bad enough. There the board found, even in the calmest weather, "a nearly constant surf, with breakers from 4 to 10 feet and over in height." Storms are said to be rare, which is fortunate, as their effect upon a practically unsheltered coast, with a "fetch" of many thousands of miles behind, must be simply irresistible.

The harbour question may, therefore, be readily epitomized. On the one hand, the terminus at Greytown would always be subject to the risk of obliteration by the Atlantic waves: on the other, the terminus at Brito would ever be liable to destruction from the roll of the Pacific breakers.

The estimate of the cost of construction published by the company is $65,000,000. A board of engineers reviewed these figures on behalf of the company, and increased them to $88,000,000. Including the sum required for payment of interest out of capital during construction, the gross estimate becomes $100,000,000.

The Ludlow board expressed a halting hope that the sum of $133,000,000 might be found sufficient for the actual construction. It is

SOME OF THE PRODUCTS OF THE COUNTRY.

reported that the Walker commission has ventured upon an estimate of $124,000,000 for the same cost.

Festina lente is the classic form of the good old Saxon proverb, "The more haste, the less speed." There are few enterprises to which the proverb does not apply, and none to which its application is of more cogent importance than that for the construction of the inter-oceanic canal. Advancing civilisation, bringing in its train the increasing requirements of a multiplying population, demands that the Central American isthmus should no longer be permitted to act as a barrier to the circulation of trade. The manner of the severance and the route which should be followed are still matters of debate, constituting a question to which no authoritative answer has been given.

The people of the United States form the principal factor upon which the settlement must depend, and it is to the United States, as a nation, that the world must look for the assurance that the settlement is the best possible, and that, when the pronouncement in favour of one route or the other is made, it shall be free from the influence of passion and from the taint of prejudice.

There is but one method by which the people of the United States can discharge this national duty and attain the object which is admittedly to be desired. That is the constitution and appointment of a competent tribunal,—a tribunal composed of men who enjoy the confidence and esteem of all that is best and most worthy in the civilised world, and whose judgment would command general acceptance. Before this tribunal let the advocates of both routes—Panama and Nicaragua—appear by counsel and present their respective schemes, supporting the project by such scientific testimony as they can produce. Let, above all things, the evidence adduced on each side be tested by competent, and therefore searching, cross-examination.* Let the enquiry be of the most public kind; let all the proceedings take place in the blaze of a light as fierce as that which is said to beat "upon the throne"; and let the decision be accepted as final by the world.

There is a disposition on the part of certain persons to attempt to rush the Nicaragua Canal project through at the present moment. High ground is being taken by these persons, patriotism is invoked, self-interest is called into play, and other efforts are being made to excite feeling, whether of a worthy or of an unworthy character. The question is too great to be settled in this manner. The American nation is but beginning to take its true place among the families of the earth; it is like the sun, rising in strength and rejoicing in the race which is set before it, and which it is just commencing to run. Paltriness of object and littleness of vision would stultify the nation at this time; petty selfishness would blight its growth. This canal question presents an opportunity to the people of the United States in which they can show that they appreciate their great place and their high position, and show it by assisting to settle the question in such a manner as will be for the benefit of humanity and for the advantage of the world. That manner will involve selection of the best possible route and of the best possible proposal,* and under present circumstances no convincing decision can be given in which such selection can be embodied, except by a tribunal of the character above indicated, sitting under circumstances such as we have ventured to recommend. America's true interest would be served by this, and all would agree to entrust the waterway constructed under America's auspices to America's trustee-like custody.

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* The necessity for cross-examination will become abundantly clear to any expert who peruses the report of the proceedings when "House Bill 35 (on the Nicaragua Canal)" was before the committee on interstate and foreign commerce of the house of representatives in Washington, in 1896.

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* Present reports are that the estimates of individual members of the Walker board vary from $90.000,000 to $140,000,000. Mr. Hunter himself says:

"Having in view the lack of necessary information, and the enormous risk which will attend upon the operations necessary for construction, experience leads to the conclusion that, if any body of undertakers were able to carry through the works and open the canal to the trade of the world at an inclusive cost of $200,000.000. these gentlemen might well congratulate themselves upon their astonishing good fortune."

THE REPUBLIC OF PANAMÁ

By Colonel G. E. CHURCH.

(*From 'The Geographical Journal' for December.*)

ANOTHER turn of the historic kaleidoscope, and this time the *trait d'union* between North and South America is an independent state. What are the physical characteristics, the geographical advantages, the prospective means for existence possessed by this newly fledged commonwealth?

Its south-eastern boundary, if the old departmental limits be maintained, will follow the Serrania del Darien, which is the *divortium aquarum* between the basin of the river Atrato and its estuary and the valley of the Tuira, which drains into the Gulf of Panamá. The line commences in the little bay of Aguacate or Octavia, in front of point Mazo or Morroquemado, and thence runs north-north-east, and then north along the summits which separate the rivers that flow to the Pacific from those which run to the Atlantic. Reaching the headwaters of the Juradó, it turns west towards the heights of Aspave. It then follows, generally in a north-east direction, the divide between the gulf of San Miguel and the river Atrato until it reaches the ocean entrance to the Gulf of Urabá, where it diverges north-west to the headwaters of the river Tarena, the course of which, until it empties into the Gulf of Urubá, serves as the most northern section of the boundary in question.*

The frontier with Costa Rica will, according to the award of President Loubet in 1900, start from Cape Mona, on the Caribbean sea, and enclose, on the north, the basin of the river Tarire (the lower course of which is sometimes called the Sixola), and then, by the watershed between the Atlantic and Pacific (which is the narrow-crested Cordillera of Talamanca), south-easterly to 9° S. lat.; thence, it will take a southerly direction and follow the divide between Chiriquí Viejo and the tributaries of the Gulf of Dulce, and terminate at Point Burica, on the Pacific ocean.

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* See Perez, 'Geografia Fisica de los Estados Unidos de Columbia.'

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A

A great river, the Atrato, flows in a deep gorge northward into the Gulf of Urabá or Darien, and separates the "Occidental Cordillera" of Colombia from the outlying parallel coast range, washed by the waves of the Pacific ocean, and known as the Sierra de Baudo. This is generally low, its highest peak being only 6000 feet above the sea. Its average elevation is from 2600 to 3300 feet, and its lowest depressions from 1000 to 1600. It is a wild chaos of ridges, highlands, and spurs, terribly ravined by torrential rains, thickly forested, and rendered almost impassable by an infinite number of rivers, brooks, and tropical swamps and jungles—a pestiferous region uninviting as a home for man.

In the latitude of the Gulf of Urabá, the extension of the Sierra de Baudo pushes into the isthmus of Panamá, on the Pacific side, as far as the mouth of the river Bayamo or Chepo, where it completely disappears. *En route*, it breaks down to give place to the Bay of San Miguel and its tributary river system of the Tuira. South-east of this bay is a low *massif* called the Altos de Aspave, and north-west of it another culminating height, broadly spurred and counterforted, which connects by a transverse ridge with the low range which overlooks the Gulf of Darien.

The Altos de Aspave throws off, to the north-east, the Serrania del Darien, which crosses from the Pacific coast to the mouth of the Gulf of Urabá. Thence it skirts the Caribbean coast as far as Puertobelo, occasionally, for long distances, rising from the seashore in bold escarpments. Its principal summits are from 500 to 2700 feet above the sea.

At the Chagres river, that *bête noire* of the Canal Company, the Sierrania del Darien completely breaks down, and the summit height between the two oceans is but 300 feet above sea-level. With the exception of the interoceanic water-divide in Nicaragua, which is 153 feet, it is the lowest break in the Andean and Rocky mountain chain between the straits of Magellan and northern Alaska.

The orographic system of the western half of the isthmus of Panamá is bolder and better defined than that of the eastern portion. The region has a broad backbone ribbed by numerous counterforts, but occasionally broadening into complex belts of highlands and isolated *cerros*. From the Costa Rica frontier, the range takes the name of Sierra de Chiriquí, then Veragua, and afterwards is known as the Sierra de Panamá. In the first is the extinct volcano of Chiriquí, 11,000 feet* elevation above the sea, but the entire sierra has an average altitude of 6500 feet. The Sierra de Veragua presents us with the dome of Santiago, which rises to 9275 feet, while the Tuta reaches 5000 and the Santa Maria 4600. The Sierra de Panamá seems to be thrown broadcast into disorderly fragments without law or regularity, and its summits nowhere exceed an elevation of 1600 feet.

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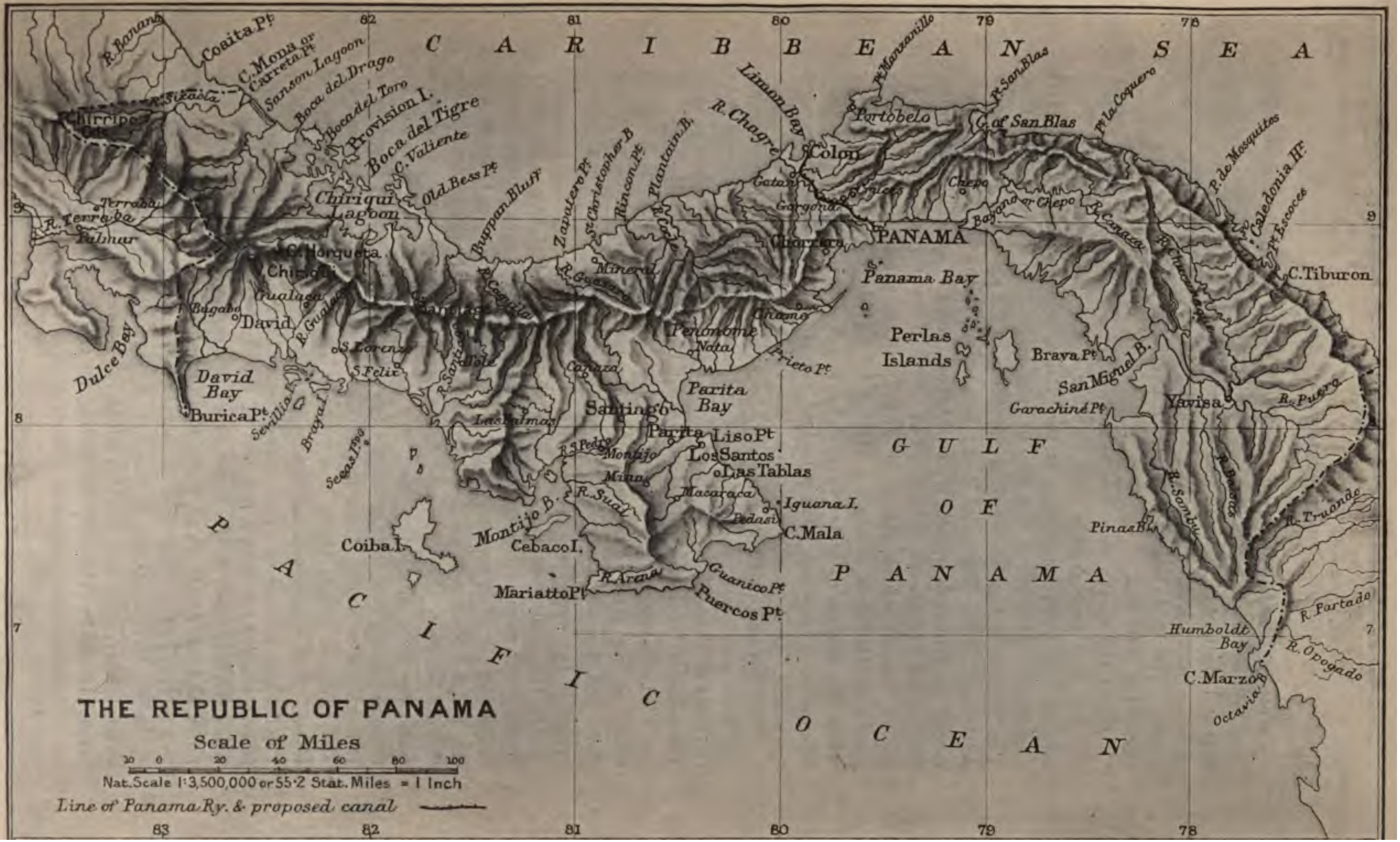
* 'Nueva Geografía de Colombia,' F. J. Vergara y Velasca.


THE REPUBLIC OF PANAMA

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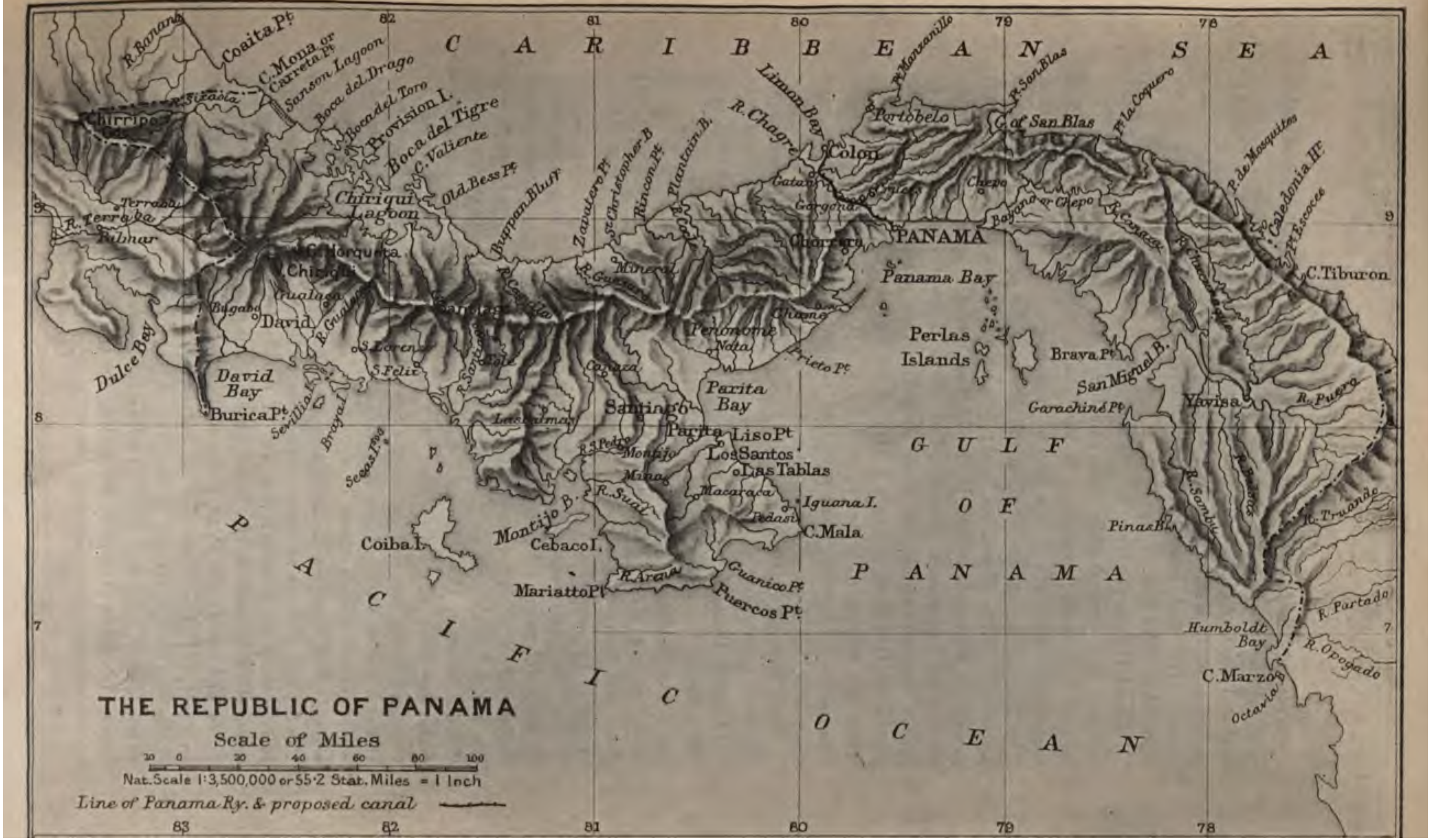

THE REPUBLIC OF PANAMA

West of Montijo bay, on the Pacific side, a broad and massive mountain outwork forms the peninsula of Las Palmas, and between that and the bay of Panamá lies the great peninsula of Azuero, which shows a capricious, distinctive orographic system of highlands and *sierras*. Its bold headlands, which overlook the ocean, rise to an altitude of 3000 feet.

About 150 short rivers flow to the sea from the northern side of the isthmus, and over double that number drain its Pacific slope. The largest and most important is the Tuira, which rises in the Pirri mountains just north of the Bay of San Miguel, and empties into this. The Tuira is navigable for river schooners as far up as the first Spanish settlement, Santa Maria del Real; but, owing to the bars, they cannot ascend to Pinogava, which is the highest point reached by the tides. During the dry season, the river-bed above tidewater is a succession of rapids, beyond which the river dwindles into a small stream. The marks on the trees indicate a rise of 16 feet during the wet season, when the volume of water carried by the Tuira and its eleven main tributaries is immense. Its principal affluent is the Chucunaque from the north. It is nearly as large as the Tuira itself.

The Bayamo, or Chepo, rises in the same knot as the Chucunaque, but flows north-west and then west and south until it discharges into the Gulf of Panamá. It is about 150 miles long, and it is claimed that 120 miles of its course can be navigated by rafts and small craft. It has a wide estuary, the entrance to which has a bar with but 2 feet of water at low tide. The remaining streams, on the Pacific side, are short and torrential and of little value, even for canoe-navigation, except in the immediate vicinity of their mouths.

On the Caribbean slope of Panamá there are but two of its many rivers which merit attention, as offering some advantages as commercial outlets for the districts they drain. These streams are the Chagres and the Teliri, known now as the Tarire in the decision of the boundary-line dispute between Colombia and Costa Rica. The Chagres, a historic waterway ever since the discovery of the isthmus of Panamá by Colombo, flows into the Caribbean Sea a little to the west of Puertobelo. It has a bar on which there are 11 feet of water, just outside the Laja reef, through which there is a passage 70 feet wide with 14 feet of water. The Chagres is navigable for boats to within 14 miles of the Pacific, and is tame or fierce according to the season. In the dry one, it is a deep ditch with a few feet of muddy water at the bottom, but when the saturated clouds burst over its drainage area of 1000 square miles, and pour into it, at times, a uniform depth of 7 inches of water in a day, the river rises over 40 feet in twelve hours, and carries with it, in its torrential race to the sea, a vast mass of tropical, arboreal rubbish, clay, mud, and detritus which it receives from its swollen tributaries. It will be extremely interesting for the engineering and financial world to watch the coming contest between the Chagres river and the United States Treasury. In comparison to the Chagres, the San Juan river of Nicaragua is a plaything.

The Tarire, the mouth of which is in lat. 9° 34′ 14″ N., runs along the southern base of the great eastern counterfort of the Talamanca-Chiriquí range, through a spacious, undulating wooded valley of 100 to 150 square miles area, having low grounds which are sometimes dry and at others swampy. Its Urén branch rises on the north-east slope of the Pico Blanco, the view from the summit of which is said to be "incomparably more extensive" than that from the crest of the Costa Rica volcano of Irazú. The Tarire is navigable for light-draft steamers for 15 miles up, but, from the Urén to Gule, there are twenty-six rapids and numerous snags. Boats carrying half a ton of goods ascend to Sapurió, 1½ miles up the Urén. Between the Tarire and the small river Tilorio further south is the crooked, narrow, and deep estuary called the Laguna de Sansán, an ancient affluent of the Tilorio, full of sharks, alligators, and fish. It receives a little stream called the Dalni, which drains an impassable swamp. South-east of and near the Tilorio is the Boca del Drago, one of the entrances to Almirante bay.*

Panamá has many bays and ports on both oceans, but the greater part of them seem to be the undisturbed home of silence and primeval solitude. There is no accessible country behind them which offers an easy field for development. He is a bold pioneer who dares to throw down the gauntlet to nature in Panamá. There she displays her forces with magnificent *abandon;* the very ocean-margin is a wall of vegetation; nearly every swamp, hill slope, mountain-side, and gorge is densely packed with growth of tree, shrub, vine parasite, and grasses, forming a tangled jungle, sweating with the effort to maintain existence under the vertical rays of a tropical sun. The view is beautiful from the deck of a vessel, and no wonder that Luiz Colombo selected a part of "Castilla del Oro" as his fairyland, where his imagination might revel to the full, but which, unhappily, could yield him no other satisfaction. Four centuries have passed since he received his grant of ducal Veragua, and although it is within easy touch by sea with North America, it remains as the great Colombo discovered it, and as it was when for centuries it was the buffer region between Aztec and Ingarial civilization, so called. With the exception of bananas, no crop could be planted which would pay for clearing the lands of such a region, and keeping them cleared; and even bananas would not flourish sufficiently well if cultivated at an altitude exceeding 1500 feet above the sea. However numerous the ports and bays of Panamá on the Atlantic side, it is probable that many more centuries must pass before they become of any marked importance as commercial centres.

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* See "Costa Rica," by G. E. Church, *Geographical Journal*, 1897.

Starting from the Costa Rica boundary, the first great well-protected sheet of water is Almirante bay, which in reality is the north-western prolongation of the laguna of Chiriquí. Together they form a vast sheet of water. The former is 13 miles long from east to west, and varies in breadth from 2 to 13 miles. Its many harbours offer secure anchorage to ocean-going ships of the largest class, which may often moor alongside the shore. A low ridge of hills borders its southern side, in some places rising boldly to several hundred feet elevation, and 2 miles inland, reaching an altitude of 1700 to 2000 feet. The bay contains many large and small islands. Its main entrances from the sea are the Boca del Drago and the Boca del Toro, the former very tortuous, but having a depth of 9 fathoms of water; the latter offers 5 fathoms, but the channel is only a quarter of a mile wide, and bordered by coral reefs. The latter entrance gives its name to a small Colombian settlement supported principally by banana cultivation, the product being shipped to the United States.

The laguna of Chiriquí is 32 miles long and 12 wide, narrowing to 5 miles at its south-eastern extremity, and 10 at its north-western. Vessels of any draft may enter it from the ocean by the Boca del Tigre by an 8-fathom channel, and find ample security in 15 to 20 fathoms of water. The eastern and southern shores are low and swampy for a long distance inland, but at one point a spur of the Veragua range penetrates to within 2 miles of the south-eastern side of the laguna, where it has an elevation of 2672 feet. The dense forest growth, which occupies the mountain-and-hill slope which surrounds nearly the whole of the Chiriquí laguna, extends upwards nearly to the water-divide between the northern and southern oceans, and, secure in its solitude, nature revels there in all the fantastic display of an exuberant vegetation. But, crossing the *serrania*, there is a marked change: the forests give way to grass lands along the mountain flanks towards the Pacific coast, and cultivated fields, pastures, and habitations of man indicate that here nature is in a less riotous mood. The distance from the Atlantic to the Pacific, across the district described, is 50 miles. The mountain slopes, owing to the ceaseless erosion of the rain-laden trade winds, are sharper on the Caribbean side than on the Pacific incline, which is also much dryer than the former. This is true of the whole isthmus—at least, that part west of the Gulf of San Miguel.

From the laguna de Chiriquí eastward to the river Chagres, the forbidding coast-line (of coral reef, sandy beach, mangrove swamp, and a few precipitous bluffs) has no sheltered anchorage. A heavy surf breaks continually along nearly the entire shore. To the westward of the Chagres river 25 miles, and to the eastward of it as far as Puertobelo, the shore is low and flat, and deadly exhalations from the swamps veil the interior of the country from view.

The so-called Bay of Colon, named in honour of Colombo, who discovered it in 1502, lies just to the east of the mouth of the Chagres river. It is poorly sheltered, and, being open to the north, is exposed to "northers," which frequently blow with such violence that the shipping is forced to run out to sea or seek shelter at Puertobelo. This place, historic in the colonial period of South America, and then the seat of the galeon trade between Spain and the West Coast, is a pestilential port without ventilation, owing to the high hills which enclose it on the north and south and prevent the winds from sweeping away the malignant miasma which constantly rises from the swamps on the east. A coral reef skirts the southern shore, and the city and the ruins of the castle of San Jerónimo are situated on the beach in the south-east corner. The width of the entrance to the port is 1¼ miles, but it soon narrows to half a mile. The depth of water gradually decreases to 7 fathoms. Puertobelo, as a harbour, is the best between Almirante bay and that of San Blas. In fact, there is no other worth mentioning.

Of San Blas, Commander Selfridge, who surveyed it, says, "It extends in a north-east and south-west direction some 20 miles, and is about 10 miles in extreme breadth. It is formed by the cape of San Blas and the outlying islands of the Mulatas archipelago, and is a most magnificent bay, with deep passages, and perfectly protected from the north winds in the dry season. In the north-west corner is an inner harbour formed by a circle of islands, with a passage leading into it. This harbour is magnificent for all purposes required as the great terminus of an interoceanic canal." General E. W. Serrell says of the Bay of Mandinga, which is at the south-west side of the Gulf of San Blas, "The water is 80 feet deep within 100 feet of the shore, and nowhere less than 60 feet deep all the way into the Atlantic ocean." The width of the isthmus at San Blas, from ocean to ocean, is 37 miles. This is the shortest interoceanic distance on the Western Continent.

From San Blas bay, for a distance of about 80 miles, is the remarkable belt of cays, islands, and reefs known as the Mulatas archipelago. The cays are sandy and mostly in clusters, but little out of water, and thickly wooded. Between them are found many navigable channels. East of the Mulatas, and as far as Port Escocés, many cays also make the coast navigation dangerous and extremely difficult; but further towards the Gulf of Urabá, these obstructions cease to exist.

Between Point Sasardi and Point Escocés is a broad line of cays, sheltering what is known as Caledonia bay, in which are two harbours, the western called Sasardi, and the eastern one known as Caledonia. The former is about three-quarters of a mile in extent, with 4 to 6 fathoms of water; and the latter, the entrance to which is obstructed by dangerous shoals, has from 8 to 9 fathoms at the anchorage. The bold Atlantic frontage of the Serrania del Darien, from the Gulf of Urabá to Puertobelo, is thickly forested, and receives the full force of the north-east trade winds, with a resultant heavy rainfall.

Turning to the Pacific coast, we find the Gulf of San Miguel, or "Darien of the south," on the eastern side of the great shallow Bay of Panamá. At its head is the Bay of San Miguel, which was a great resort for the buccaneers, who reached it from Caledonia bay in ten days by one of the routes which served for communication between the two oceans by the Indian tribes before the discovery of America. The bay is over 6 miles wide at its mouth. It has plenty of water on its eastern side, but is shallow on its western one. As at Panamá, it has a tidal range of 20 feet or more, while Caledonia bay, on the Caribbean side, like Colon, is almost tideless. Darien harbour, at the head of the gulf or estuary of San Miguel, extends in a south-east direction up to the village of Chupigana, where it receives the Tuira and Savana rivers. Its deep water affords anchorage to the largest ships. Mangrove swamps, backed by thickly wooded hills, are almost continuous along its shores.

The island-filled Bay of Panamá, at the head of which is the famous city of the same name, is well known. It commences at Cape Garachina at the southern entrance of the Gulf of San Miguel, makes a majestic sweep concave to the south, and terminates at Cape Malo, which is the south-east cape of the great peninsula of Azuero. The direct distance between the two capes is about 100 miles. The northern part of the bay is shallow, and large ships have their anchorage near the famous island of Taboga, 9 miles south of the city of Panamá. On this island Pizarro, Almagro, and Luque made their famous contract to discover and conquer the empire of the Ingas. The latter was cheated out of his share of the plunder, and Almagro was garroted in prison at Cuzco by the brother of Pizarro. Sailing-craft find it extremely difficult to get in or out of the Bay of Panamá, but especially out. It is one of the most tedious and difficult bits of navigation in the world. Pizarro was the first to try it, in November, 1525, but, after seventy days, was forced to abandon the effort to leave the bay; and it is still the similar experience of nearly every craft unaided by steam. It is a region of calms, doldrums, vexatious currents, squalls, rains, and tormenting heat.

The city of Panamá is situated on high ground at the foot of Ancon hill, but west of old Panamá, which was destroyed by the buccaneers under Morgan in 1673. To the mouth of the river Bayámo, about 25 miles, and for another equal distance to the south-east, the coast is flooded, and at low water mud flats are exposed for a distance of 3 miles from the shore; but further on, as far as the Gulf of San Miguel, the margin is higher, with occasional small hills. From Panamá south-west to the Bay of Parita, on the western side of the Bay of Panamá, the coast-line is considerably broken, and alternates between high and hilly ground and low flooded areas, the whole shore-line being generally of mud. The entire shore of the Bay of Parita is flooded land, and has a forbidding mud flat extending from 2 to 3 miles out. From this bay to Cape Malo, about 40 miles, the coast is well out of water and backed by the highlands of the peninsula of Azuero.

The southern front of this peninsula varies much in character; west of Cape Malo for about 25 miles, the lowlands soon give place to the escarpments of the cerros, which rise to a considerable altitude further inland, and the remainder of the frontage overlooks the ocean, the mountains, furrowed with gorges, pushing boldly down to the coast. The west side of the peninsula, which partly shelters the Gulf of Montijo, is high ground at times, and at others low with occasional beaches. It has many little bays, with a south-western exposure, which receive the torrents that descend from the mountains.

The Gulf of Montijo, penetrating north about 20 miles, has an opening of some 14 miles. The short river San Pedro flows in at its head, and is navigable for small craft about 17 miles up to the port of Montijo, where there is a little traffic. The gulf has several large and small islands, the principal one, Sabaco, lying off its mouth and completely sheltering it from the south winds.

West and north-west from the Gulf of Montijo, as far as the Bay of David, the coast for the first 20 miles is sharply defined: thence, as far as Espartal island, many hill spurs push down to the sea; the shore then becomes low and cut by numerous small streams. The whole coast, from Montijo's gulf to David bay, has many little bays, most of which are available for vessels of very light draft. The bay last named is filled with cays, reefs, and hilly islands. At its head it receives the river David, which, with its tributaries, drain a vast amphitheatre of mountains which abut upon a broad plain surrounding the little port of David near the river delta. The river has its sources in the *serrania* of Chiriquí, and several of its branches drain the south-eastern slopes of the great volcanoes of Chiriquí and Horqueta, the latter 6600 feet elevation. West of the delta of the David, the coast-line bends in a great curve to the south until it reaches Point Burica at the termination of a peninsula formed by a rugged spur of the Chiriquí mountains.

The Pacific coast-line of the isthmus of Panamá is about one-third greater in extent than that of the Caribbean side. There are many islands along both coasts, but those on the Pacific are more numerous and larger than those on the Atlantic.

A thick, dark, primitive forest covers at least three-fourths of the state, and the vegetation in countless forms fights strenuously and ceaselessly with man for possession of the soil. It is nature's favourite tropical hot-house.

The extreme length of Panamá, from Colombia to Costa Rica, is about 480 miles, and it varies in width from 37 to 110. Its area is between 33,000 and 34,000 square miles, being more than one-half as large again as its last-named neighbour. About five-eighths of it consist of wild, unoccupied lands, and the remainder is but very rudely utilized by its inhabitants. The population was officially estimated, in 1898, at 340,000, representing such a heterogeneous amalgamation of Spanish, negro, and Indian blood, stirred together by the buccaneers of colonial times, that *white* may, in Panamá, be strictly classified as a colour. Until I saw a Panamá "army" of 150 men at drill, I had no idea that the human form could take such shapes and colours—Proteus would have envied them. And yet these men, like all the Colombians, are first-class fighters, and, well officered, are a foe not to be despised by the best troops ever likely to come into collision with them.

Panamá has but slender and insufficient resources to warrant its secession from Colombia. It is doubtful if the step would ever have been taken without external influence—the Panamá Canal company will probably save $40,000,000 by the change.

That Panamá can have an autonomous existence is doubtful. It is now simply a belt of country occupying a privileged geographical position, and must, for many years to come, rank with Honduras, unless the expenses of its administration be admitted as a first charge upon the net revenues of the projected canal, should there be any.*

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* For an estimate of these revenues, and for details as to the projected Panamá Canal, see "Interoceanic Communication on the Western Continent," by G. E. Church, the *Geographical Journal*, March, 1902.

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THE REPUBLIC OF PANAMÁ

By Colonel G. E. Church.

(*From 'The Geographical Journal' for December.*)

Another turn of the historic kaleidoscope, and this time the *trait d'union* between North and South America is an independent state. What are the physical characteristics, the geographical advantages, the prospective means for existence possessed by this newly fledged commonwealth?

Its south-eastern boundary, if the old departmental limits be maintained, will follow the Serrania del Darien, which is the *divortium aquarum* between the basin of the river Atrato and its estuary and the valley of the Tuira, which drains into the Gulf of Panamá. The line commences in the little bay of Aguacate or Octavia, in front of point Mazo or Morroquemado, and thence runs north-north-east, and then north along the summits which separate the rivers that flow to the Pacific from those which run to the Atlantic. Reaching the headwaters of the Juradó, it turns west towards the heights of Aspave. It then follows, generally in a north-east direction, the divide between the gulf of San Miguel and the river Atrato until it reaches the ocean entrance to the Gulf of Urabá, where it diverges north-west to the headwaters of the river Tarena, the course of which, until it empties into the Gulf of Urubá, serves as the most northern section of the boundary in question.*

The frontier with Costa Rica will, according to the award of President Loubet in 1900, start from Cape Mona, on the Caribbean sea, and enclose, on the north, the basin of the river Tarire (the lower course of which is sometimes called the Sixola), and then, by the watershed between the Atlantic and Pacific (which is the narrow-crested Cordillera of Talamanca), south-easterly to 9° S. lat.; thence, it will take a southerly direction and follow the divide between Chiriquí Viejo and the tributaries of the Gulf of Dulce, and terminate at Point Burica, on the Pacific ocean.

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* See Perez, 'Geografia Fisica de los Estados Unidos de Columbia.'

A great river, the Atrato, flows in a deep gorge northward into the Gulf of Urabá or Darien, and separates the "Occidental Cordillera" of Colombia from the outlying parallel coast range, washed by the waves of the Pacific ocean, and known as the Sierra de Baudo. This is generally low, its highest peak being only 6000 feet above the sea. Its average elevation is from 2600 to 3300 feet, and its lowest depressions from 1000 to 1600. It is a wild chaos of ridges, highlands, and spurs, terribly ravined by torrential rains, thickly forested, and rendered almost impassable by an infinite number of rivers, brooks, and tropical swamps and jungles—a pestiferous region uninviting as a home for man.

In the latitude of the Gulf of Urabá, the extension of the Sierra de Baudo pushes into the isthmus of Panamá, on the Pacific side, as far as the mouth of the river Bayamo or Chepo, where it completely disappears. *En route*, it breaks down to give place to the Bay of San Miguel and its tributary river system of the Tuira. South-east of this bay is a low *massif* called the Altos de Aspave, and north-west of it another culminating height, broadly spurred and counterforted, which connects by a transverse ridge with the low range which overlooks the Gulf of Darien.

The Altos de Aspave throws off, to the north-east, the Serrania del Darien, which crosses from the Pacific coast to the mouth of the Gulf of Urabá. Thence it skirts the Caribbean coast as far as Puertobelo, occasionally, for long distances, rising from the seashore in bold escarpments. Its principal summits are from 500 to 2700 feet above the sea.

At the Chagres river, that *bête noire* of the Canal Company, the Sierrania del Darien completely breaks down, and the summit height between the two oceans is but 300 feet above sea-level. With the exception of the interoceanic water-divide in Nicaragua, which is 153 feet, it is the lowest break in the Andean and Rocky mountain chain between the straits of Magellan and northern Alaska.

The orographic system of the western half of the isthmus of Panamá is bolder and better defined than that of the eastern portion. The region has a broad backbone ribbed by numerous counterforts, but occasionally broadening into complex belts of highlands and isolated *cerros*. From the Costa Rica frontier, the range takes the name of Sierra de Chiriquí, then Veragua, and afterwards is known as the Sierra de Panamá. In the first is the extinct volcano of Chiriquí, 11,000 feet * elevation above the sea, but the entire sierra has an average altitude of 6500 feet. The Sierra de Veragua presents us with the dome of Santiago, which rises to 9275 feet, while the Tuta reaches 5000 and the Santa Maria 4600. The Sierra de Panamá seems to be thrown broadcast into disorderly fragments without law or regularity, and its summits nowhere exceed an elevation of 1600 feet.

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* 'Nueva Geografía de Colombia,' F. J. Vergara y Velasca.

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THE KEY TO THE PACIFIC

Compliments of
E NATIONAL BANK OF THE PACIFIC
AT SAN FRANCISCO

LONDON.
1906.

I HAVE been so strongly impressed by two articles in the late magazines, one on "The Commercial Prize of the Orient," by Hon. O. P. Austin, Chief of the Bureau of Statistics, in the *National Geographical Magazine* for September, 1905, and one on the "Panama Canal," by Mr. William Barclay Parsons, the distinguished engineer, and member of the Isthmian Canal Commission, published in the November *Century,* that it has seemed to me that an article, demonstrating the position of San Francisco in reference to the commerce of the far East and the part she will take therein, would be interesting.

I have therefore quoted both Mr. Austin and Mr. Parsons and have illustrated the engineer's statement in regard to the location of San Francisco on the great highway between Panama and Yokohama by a chart drawn by Mr. John T. McMillan, nautical expert of the U. S. Hydrographic Office, and commend the article to the attention of thoughtful business men. It will be seen that the measurements of Mr. McMillan, which are official, will differ slightly from the figures of Mr. Parsons.

ZOETH S. ELDREDGE.

JANUARY, 1906.

LONDON.
1906.

The Key to the Pacific.

In a recent address to the National Geographical Society, Mr. O. P. Austin shows how for more than 4,000 years the nations of the West have struggled for the control of the commerce of the East. This rich commercial prize has grown by advancement of civilization, expansion of the wants of man, and the better and cheaper methods of transportation until it now reaches the sum of nearly three thousand millions annually. But great as has been the commercial development of the East, it is, when the population is considered, insignificant compared with that of Western nations. Mr. Austin shows that the Orient, having more than one-half of the world's population, and more than one-third of its land area, has but one-eighth of the world's commerce.

The reason for this disparity of growth may be found in the development by western nations of the steamship, the railroad, and the telegraph, while the East has been handicapped by lack of means of transportation and communication.

The most rapid development may be found in Japan, which, in 1874, had no railways and a foreign trade amounting, according to Mr. Austin, to $42,651,000; but in 1904, thirty years later, had 4,500 miles of railway

LONDON.
1906.

steamers will be stopping daily. These steamers will make San Francisco a great competitive point for through freight shipments."

Thus the great engineer. Passengers going from San Francisco to Yokohama before the acquisition of Hawaii, found that instead of sailing for Yokohama by the rhumb-line—that is, always on one course—the ships took a course to the northwest and sailed up to forty-eight degrees, making what is known as the great circle, thereby cutting 246 miles from the distance between the two ports.

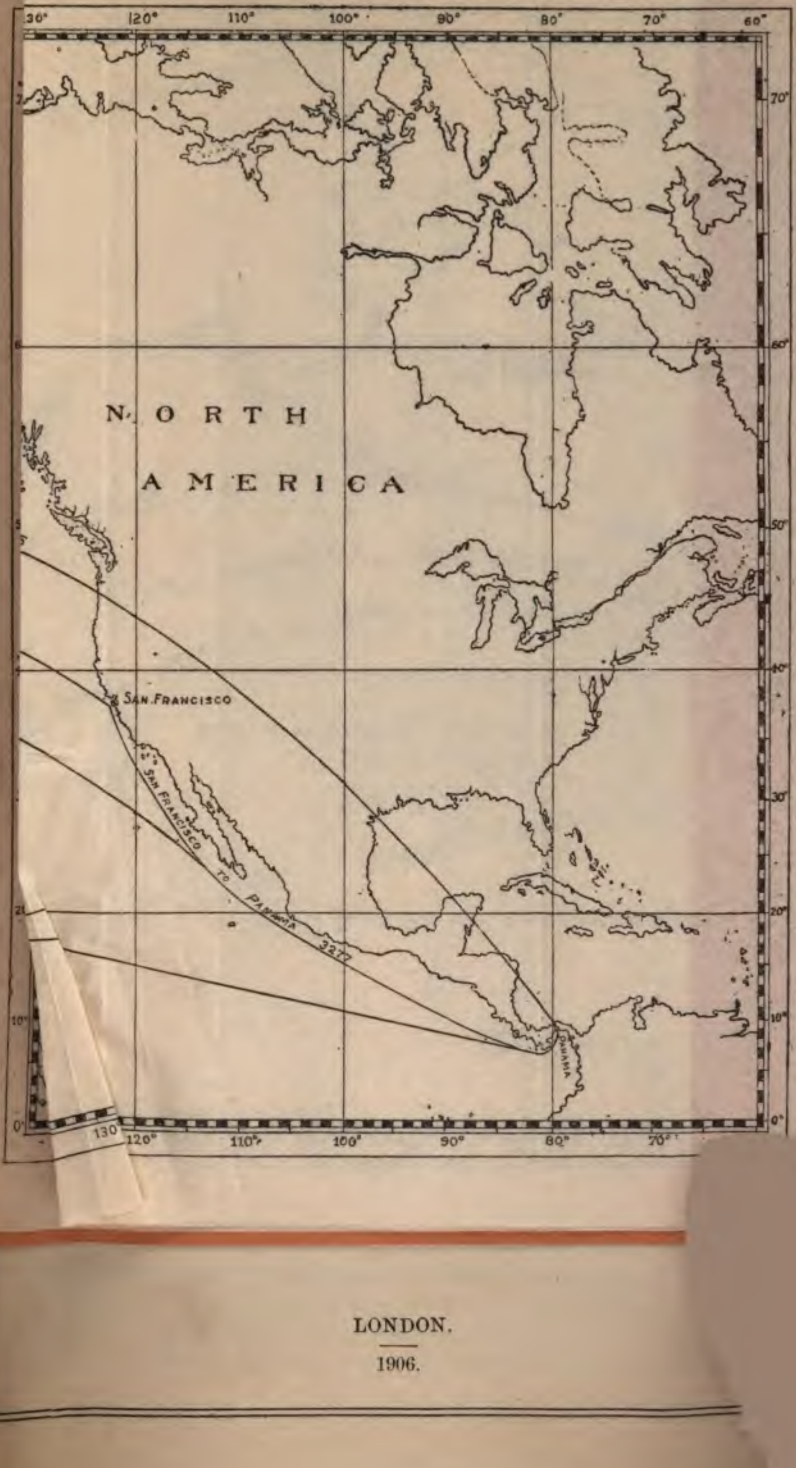
The U. S. Hydrographic Office publishes a gnomonic chart of the Pacific Ocean, a curious and interesting affair whereon the land areas are strangely distorted. This gnomonic chart is based upon a system of projection, the plane of which is tangent to the earth's surface at a point on the equator in longitude 155° west of Greenwich, and the eye of the spectator is supposed to be situated at the center of the earth, whence, being at once in the plane of every great circle, it will see these circles projected as straight lines. A straight line drawn between any two points or places on the chart represents an arc of the great circle passing through them, and is, therefore, the shortest possible track between them, showing also all the geographical localities through which the most direct route passes. The great circles shown on the accompanying map, which is the ordinary Mercator projection, are constructed from data taken from the gnomonic or great circle chart.

Mr. Parsons says in conclusion, that the "canal will bring the grainfields of the northwestern Pacific States 6,000 miles nearer Liverpool, and it will bring the iron and coal of the Gulf States shipped from New Orleans and Pensacola 9,500 miles nearer San Francisco; giving to the former a new great market not now open and to the latter a cheap supply of the raw materials of manufacturing."

In writing of the advantages that will accrue to San Francisco in the way of manufactures, Mr. Parsons did not enter into the matter of oil production in California. California is the largest oil-producing state in the Union, and the product is far in excess of consumption. But the use of oil as fuel is in its infancy. The statistics of the Agricultural Department give the use of petroleum as but 3% of the total amount of fuel used. Its use for this purpose is being rapidly extended, and its excellence and cheapness make it most desirable for all manufacturing plants, locomotives, steamships, etc. The Orient is a large importer of cotton and cotton goods, mineral oils, manufactures of iron and steel, flour, and meats. The import of cotton goods alone amounts to two hundred and fifty millions per year. There is no reason why San Francisco, with its location and its cheap fuel should not become a great manufacturing center.

LONDON.
1906.

That the situation of San Francisco is beginnin be appreciated is shown by the present activity in road building, both in trans-continental and local tr lines. In addition to its other commercial advantage may be said that San Francisco occupies a unique p in the temperate zone, being subject to none of the dr backs of less favored points. It has neither extreme nor extreme cold; it is not subject to great storms, an ship properly manned and found has ever been lost lee shore.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1906.

NOTES

ON THE

REPUBLIC OF COLOMBIA

AND

THE QUESTION OF THE

PANAMA CANAL SHARES

BY

GENERAL JORGE HOLGUIN

Financial Delegate of Colombia in Europe, Member of the Colombian Senate, Ex-Minister Plenipotentiary, &c.

◆

LONDON.

1906.

THE REPUBLIC OF COLOMBIA.

Colombia, following the example of the Argentine Republic, Brazil and Uruguay, is taking her place with those Latin-American countries which, by the prevalence of internal peace and security, and the improvement of their financial and economical position, have regained the credit and esteem lacking for a considerable period.

Quite recently Colombia was represented, in telegrams published in Washington, as being still in a state of revolution. This news, disseminated in the European Press on two different occasions and at short intervals, was proved false.

In a letter which General Reyes, the President of Colombia, addressed to me on November 13th, 1905, he dealt at length with these false and injurious rumours; and, although not intended primarily for publication, I will quote his own words, the underlying sincerity of which is beyond question:—

"I see with great regret, although it does not astonish me, that any false news, such as, for instance, the cable announcing the rising of the people and my having been declared Dictator, is too readily credited, and has a disastrous effect on our credit, even when it is proved to be false and authoritatively denied. Once for all, I will state the reasons which have caused me to send you repeated cables asserting that peace in our country is firm and durable, and that I will answer for its preservation and maintenance. My reasons are the following:—

"Having for 15 months adhered honourably and inflexibly to my program of not being the leader of any one particular political party, but the head of the Government of the whole country, the result has been that political parties and groups have disappeared as if by enchantment, leaving in their place only dissociated cliques, that daily become more discredited and isolated, whether calling themselves 'Blues' or 'Reds.' In consequence of this, it has been possible to reduce the Army to 4,000 men, who are all employed as sappers in improving the roads, streets, and public buildings of our towns.

"Peace, therefore, rests on the unanimous wish of the whole nation, supported in turn by a Government resolutely determined on the preservation of order and the punishment of those who attempt to disturb it. It is but fair to recognise that, since I undertook the Government, there has not been any attempt at a revolutionary movement; on the other hand, there has not been a single act of the Government which is not strictly in accordance with the Laws and Constitution of the country. For the settlement of all the questions that have arisen the established Laws have proved amply sufficient. Under the Laws of the country I have hitherto governed, and shall continue to govern, without giving anyone just grounds for laying to my charge a single illegal act, or to denounce me as a Dictator. All this gives a tremendous moral force to the Government, especially when one remembers the great influence that has always been exercised by the legal element in our country.

"The results which have accrued, based on the confidence which is generally felt throughout the country in the permanence of peace, are really surprising. I will cite one or two instances in proof. I go out into public, walking or driving, and into the country, without any escort, just as any private gentleman might do, and meet with nothing save respect and consideration; I drive out daily with my daughters; I stayed at Fusagasuga for a change for more than a month, but always with the same result—consideration and respect, joined to perfect orderliness.

"Here is another instance of the new spirit of respect for order showing itself. As a result of the working of a native spirit monopoly, established for the first time in the Department of Tolima, the people of Campoalegre made a public demonstration of protest.

"The Governor, Rafael Puyo, who was at Neiva, greatly alarmed at this, applied to me for a battalion to proceed to the scene. I immediately instructed him to proceed thither with his secretary, and to call upon the three principal ringleaders to appear before the Intendant to answer for their participation in the disorder, adding that if they disregarded his authority, I would attend to the matter personally. I was not troubled any further in the affair. Three of the principal malcontents, escorted by only two police agents, presented themselves before the Intendant at Garzon with a satisfactory defence, and were then allowed to return home.

"I would not claim that the evil habit of 'pronunciamientos' or conspiracies has disappeared completely—bad habits are not got rid of in a day—but what I do assert is that the Nation at large has learnt its lesson by painful experience, and resents any attempt to breed further trouble. The great majority of the people demand laws which shall prove sufficient to prevent, if possible, further public disturbances, or to punish the offenders.

"Everyone in the country is now convinced that Colombia owes it to her civil wars that in progress she has fallen behind such countries as Brazil, the Argentine and Chile. Our country requires not only peace, but repose; and believes that, with twenty years of peace, its progress and wealth will astonish the world. And I assert that peace is the wish and the will of the Nation—that the best policy of the Government, the best Army, is public opinion. And it is for this that I do not hesitate to affirm that peace is definitely assured in Colombia."

The letter of President Reyes then gives details of the new revenues up to date, and an estimate for the ensuing year, as follows:—

DATA RELATING TO COLOMBIAN REVENUE extracted from letter of President Reyes addressed to General Holguin, Financial Delegate of Colombia in Paris:—

REVENUE FROM THE NEW DUTIES.

DUTY ON LIQUORS:		
Proceeds up to October 31st, 1905	$68,191,344	
Proceeds from November 1st, 1905, to November, 1906		$155,673,000
DUTY ON HIDES:		
Proceeds from July 1st, 1905, to October 31st, 1905	29,293,250	
Proceeds from November 1st, 1905, to December 31st, 1906		104,300,000
DUTY ON TOBACCO:		
Proceeds from March 15th to October 31st, 1905	7,382,647	
Will produce November 1st, 1905, to December 31st, 1906		66,900,000
DUTY ON CIGARETTES:		
Has produced from March 15th to October 31st, 1905	4,903,304	
Will produce from November 1st, 1905, to December 31st, 1906		60,000,000
DUTY ON MATCHES:		
Has produced from March 15th to October 31st, 1905	2,015,251	
Will produce from November 1st to October 31st, 1906		42,000,000
CATTLE-SLAUGHTER TAX:		
Has produced from March to July, 1905 ...	10,312,213	
Will produce in Boyacá alone to December 31st, 1906		2,700,000
Total (paper money)	$122,098,009	$431,573,000
Equivalent in gold at the legal exchange of 10,000 per cent., or one cent gold for one paper $ ...	$1,220,980	$4,315,730

To these amounts must be added:—

The revenue from the Sabana Railway to December 31st, 1906, which is estimated at $15,000 monthly	$190,000
Marine salt pits for the same period, at $20,000 monthly	280,000
Consular fees for the same period, at $50,000 monthly	700,000
Muzo emeralds for the same period, at $50,000 monthly	700,000
Total	$6,185,730

Revenue controlled by the Central Bank.

The further revenue can be estimated up to December 31st, 1906, as follows:—

Customs	$5,000,000	
Land salt pits	600,000	
Post and Telegraph	500,000	
Stamps and Stamped Paper	500,000	
Export of Gold, Mine Duties, Lighthouses, etc ...	400,000	
		$7,000,000

Estimated revenue to December 31st, 1906	$13,185,730

The President continues: "With the impetus the country is receiving from its railway development, it is probable that this estimate of $13,185,730 will be exceeded, that the return will amount to $15,000,000 gold in 1906, and after that to more than $20,000,000 gold per annum, equivalent to a yearly sum per head of $5, taking the population of the country at 4,000,000.

"The Central Bank is now definitely established, and, with the resources in gold upon which it can count, should continue developing on sound and safe lines, without the assistance of foreign capital. This bank still holds its own funds in gold, and those arising from the Government revenues, amounting at present to about $1,000,000 gold. If the question of the Canal shares is satisfactorily settled, this amount should be increased to $2,000,000 gold.

"Since January last I have been preparing for the conversion of the paper money into gold. Gold will be coined at the Mints of Bogotá and Medellin. Silver money will also be coined for the country's use, in due legal proportion. Nickel will also be imported for subsidiary coinage in the country, of which a proportionate amount will be coined. I estimate that 8 million dollars gold will suffice for the conversion, as I consider that a great amount of paper money has been lost and deteriorated."

The foregoing letter of President Reyes is, I consider, the best denial that can be given of the injurious reports of disturbances in a country whose most strenuous efforts are now being intelligently directed to gaining an honourable position among the nations of the world.

Based entirely on official documents in my possession, the following short review of the financial position of Colombia, its resources, and the manner in which these resources are being utilised, should be of general interest to English investors, who have material interests in Colombia:—

New Monetary Law.—This Law, enacted by the Colombian Congress, came into operation on January 1st, 1906. It provides for the conversion of the existing paper currency into gold. In accordance with the provisions of this Law, President Reyes has signed a Decree authorising the appropriation of 25 per cent. of the new revenues for this purpose. The Decreé states that it has been judged advisable that measures should be adopted for the deposit in foreign banks of sufficient funds in gold to cover the establishment of a metal currency before January 1st, 1906.

The best and the simplest way of effecting this deposit is to allocate for the purpose the revenue derived from some particular duty payable in gold, or some other source of revenue of the same nature, which can be disposed of without in any way affecting unfavourably the civil service of the country itself. The duty on hides exported from the country is the one which best fulfils these conditions; the revenue admitting of easy collection, and being of a regular nature, is probably the one best calculated for the purpose of covering the direct and immediate conversion of the paper currency and providing a guarantee for any operations requiring credit.

Consequently, a duty on hides has been imposed in Colombia, dating from July 1st, 1905. The Central Bank, under the authority of the Minister of Finance, has organised this in such a way as to secure the highest possible return from the duty, as well as the sale of the hides abroad.

The product of the revenue from hides is estimated at 25 per cent. of the new sources of revenue created and destined for the currency conversion during the first year, and at 50 per cent. thereafter. If the receipts should not amount to the 25 and 50 per cent. respectively of the new duties, the deficit will be made good from the Emerald Mines revenue.

Furthermore, if the financial position of the Treasury admits of it, the total revenue derived from the Muzo and Cosquez Emerald Mines, as well as the export duties, will be applied for conversion purposes.

The monetary unit is the gold dollar, divided into 100c, weighing 1.672 gr, standard 0.900. The other gold coins are: The double-condor, worth $20; the condor, worth $10, and the half-condor, worth $5. Silver money will also be coined—the half-dollar, worth 50c gold; the peseta, worth 20c gold, and the real, worth 10c gold. All these silver coins will be of the standard 0.900 of fine gold, equivalent to 33 grammes of silver. Against every $100 worth of gold put into circulation only $10 of silver can be issued. Finally, smaller coins—copper, nickel or bronze, of 5c, 2c and 1c denomination—will be issued, but this issue is not to exceed 2 per cent. of the gold in circulation.

THE FOREIGN DEBT.

In its issue of July 19th, 1905, the "Diario Oficial" published the ratification by President Reyes, under date of June 30th, of the settlement effected between Lord Avebury, the President of the Committee of Foreign Bondholders, and myself, acting as Financial Delegate of Colombia.

According to the terms of this agreement, the Colombian Government undertook to make the payments, as from July 1st, 1905, of the arrears of the Debt on the bases of the 1896 Convention, the first coupon payable being that falling due January 1st, 1906, at the rate of 2½ per cent. per annum, the following interest coupons being at the rate of 3 per cent.

The amortisation of the capital amount, which was agreed at £2,700,000, to commence from July 1st, 1905, from the funds set aside for the purpose in the 1896 Convention. The first Sinking Fund operation, in January, 1906, to be at the rate of ½ per cent. of the capital amount, to be increased successively to 1½ per cent., until the complete extinction of the Debt.

As a guarantee for the payment of the yearly interest, the Government has allocated 15 per cent. of the Customs revenues. The payment of the arrears of interest, amounting to £351,000, will be effected as follows:—The Bondholders receive Custom-House bonds for an amount of £175,000, or half the nominal value of the certificates. The bonds will be guaranteed by a special assignment of 15 per cent. of the Customs from January 1st, 1906.

For the balance remaining the Colombian Government undertake, when the legal proceedings actually pending in France have ended in their obtaining possession of the 50,000 shares in the New Panama Canal Company, to pay to the Bondholders the sum of £70,200, to liquidate a further 20 per cent. of the nominal value.

In addition, should the efforts now being made to obtain pecuniary compensation from the United States have a successful termination, the Colombian Government will immediately pay to the Bondholders £105,300, the remaining 30 per cent. of the nominal value of the certificates.

On signing the ratification of this agreement, General Reyes introduced three modifications. The first (of no importance) substituted the name of the Central Bank in place of the Bank of Bogotá for the service of the Debt; the second, rendered necessary in view of the actual state of the Colombian Treasury at that time, delayed for a term of five years the commencement of the operation of the Sinking Fund, which will commence, therefore, on July 1st, 1910, instead of on July 1st, 1905, as first arranged; and, finally, the clause reserving to Colombia the right to claim from Panama a proportion of the general Colombia Debt was eliminated.

As the Government of Bogotá has not up to the present officially recognised the Panama Government, General Reyes probably considered it inexpedient, as a matter of policy, to thus hamper his free action.

The Colombian Government has scrupulously carried out all its engagements (with the exception of the Sinking Fund—which provision will not become operative until the date agreed upon) since the official ratification of this agreement. The improvement in the country's credit in England is proved by the fact that Colombian bonds have risen in value from 25 per cent. to 45 per cent. on the London Stock Exchange.

RAILWAY DEVELOPMENT.

The "Diario Oficial" published on August 14th, 1905, the text of the contract between the Government and an English company for the construction of a railway connecting the Port of Girardot, on the Upper Magdalene River, with Honda, situated on the Lower Magdalene. The contract provides for the line to be opened for traffic within five years of the commencement of the work. A further term of a year may be granted for its completion, provided that at the end of the five years not less than 50 kilometres (1 kilometre nearly ⅝-mile) of railway have been laid. The company receives a subsidy from the Government of $9,000 gold (£1,800), payable in bonds, for every kilometre constructed.

The railways connecting the Capital with the coast are the following:—

1. The Colombian National Railway Company, Limited (an English Company), connecting Bogotá with the Port of Girardot, on the Upper Magdalene, the construction of which is proceeding in a satisfactory manner.

2. The Colombian Western Railway Company, Limited (English), connecting the Ports of Girardot and Honda, of which mention is made above.

3. The La Dorada Railway Company, Limited (English), connecting the river ports of Honda and La Dorada, which has been working satisfactorily for a number of years.

4. The concession granted to Mr. J. T. Ford (an American citizen), to connect La Dorada with a point on the Magdalene lower than Carare. The construction of this line will shorten the boat journey to Calamar, the terminus of the Calamar and Magdalene Railway (American), to 125 leagues (375 miles), and the water journey to Barranquilla, the terminus of the Barranquilla Railway and Pier Company (English), to 147 leagues (441 miles).

The concession granted to Baron Schmatzer and Mr. J. Patiño for the construction of a railway between Puerto Wilches and Bucaramanga.

The "Diario Oficial" of August 19th, 1905, published the text of a contract between the Government and Mr. Charles Tanco, the owner of the Tolima Railway, for the extension of this line from Girardot, its starting-place, to the bridge at the mouth of the Magdalene. At present, passengers and goods from Europe, on arriving at the coast of Colombia, in order to reach the Capital, have to ascend the River Magdalene for a distance of 230 leagues (690 miles). The most important part of this contract is comprised in that portion which provides for a juncture to be effected on this line between Bogotá and the Port of Buenaventura, on the Pacific.

The Government has given a concession to a French Company, under the management of Mr. Maurice Brochet, for the construction of a railway line. This, perhaps, may be considered the most important of all. Starting from Bahia-Honda, one of the chief ports of Colombia, on the Atlantic side, this line will traverse the whole Department of Santander, with its terminus at Bucaramanga.

The "Diario Oficial" of December 23rd, 1905, publishes the text of a contract between the Government and the Colombian Northern Railway Company, Limited, for the extension of the Northern Railway from Cipaquirá to Chiquinquirá. This extension will complete the linking-up of the principal towns on the Bogotá Plateau.

COMMERCE.

The year ending June 30th, 1904, showed a considerable increase in exports compared with the previous year. These exports consisted principally of coffee, cocoa, tobacco, rubber, hides, gold dust and bars, balsam essences, "Panama" hats, etc., etc., and exceeded $12,000,000 gold (£2,400,000) in the period mentioned. The United States take about 60 per cent. of the exports from Colombia.

The International Bureau of the American Republics at Washington forecasts a great development in Colombia's trade if internal peace is maintained. (Monthly Bulletin of November, 1905.)

PRECIOUS STONES.

The exploitation of emeralds is the only precious stone industry carried on in Colombia, and large quantities of gems are obtained from the Muzo Mines, situated in Boyacá, within a mule journey of 70 miles from the River Magdalene and 670 miles from the Atlantic coast.

These mines belong to the Colombian Government, which works them by means of a national company. This company receives a percentage on the output.

In latter years the revenues derived by the Government from the Emerald Mines have amounted to $1,000,000 (£200,000) annually. The Government has the monopoly of emerald mining in the country, and the Colombian variety is unrivalled by emeralds from any other part of the world. Muzo emeralds enjoy amongst lapidaries a unique reputation.

Other emerald mines have been discovered in Colombia, but the quality of the stones leaves much to be desired. The Colombian Government is considering means to work the mines to better advantage by the most recent and up-to-date methods, which will undoubtedly considerably increase the returns—perhaps more than double them.

GARNETS.—These are found in great abundance in the auriferous alluvions of the Department of Tolima, near the River Magdalene, 600 miles from the Atlantic.

QUESTIONS PENDING WITH FRANCE AND THE UNITED STATES.

It was hoped that before this a settlement would have been arrived at in the question at issue between Colombia and the new Republic of Panama with regard to the proportion of the Colombian Debt which Panama should assume. For the purpose of arriving at a settlement, a meeting of the Bondholders was held in London on December 8th, 1904, and the following resolution unanimously passed:—

"That the Bondholders of the Colombian Debt congratulate His Excellency, Mr. Theodore Roosevelt, on the occasion of his re-election to the post of President of the United States of America, and respectfully request him to act as arbitrator between the Government of Panama and the said Bondholders for the purpose of determining what proportion of the Foreign Debt of Colombia should be assumed and paid by the Republic of Panama."

This resolution, transmitted to Washington, failed to secure the adherence of President Roosevelt, who declined the request to act as arbitrator on the ground that Panama had not made a similar application, and that no negotiations had taken place between the Republics of Colombia and Panama for submitting this question to arbitration.

The representatives of the Bondholders replied at some length to this statement. They declared that of the large sums paid by the United States for the concession of the Panama Canal, a part at least should be returned to Colombia, who had lost her best Province by the secession of Panama from the Mother Country; but no reply was received to this representation.

With regard to the arbitrary sequestration by the Fiscal authorities of France of the 50,000 shares of the New Panama Canal Company, there is very little doubt that this will be finally settled in favour of Colombia.

In reply to a long and important communication on this subject which I addressed to the French Minister of Finance in my character of Financial Delegate of Colombia, in which I clearly stated the grounds on which Colombia bases her claim for the restitution of these shares, and maintains that their seizure on the part of France has been unjust and illegal, the Minister, under date of December 18th, 1905, has informed me that he will study this question with the care which it merits. There is, therefore, every ground for believing that an equitable solution will be shortly arrived at.

COLOMBIA'S RESOURCES.

The question now presents itself: What are the natural resources of Colombia to enable her, not only to meet her engagements, but to become an important factor in the world's riches?

Colombia has a superficial area of 133,100,000 hectares (1 hectare = 2.471 acres). Land which is cultivated, and more or less populated, accounts for about 35,000,000 hectares. The remainder is uninhabited and virgin land. The territory of Colombia, therefore, is two and a-half times greater than that of France. It is nearly four times greater than the whole of the United Kingdom.

The animal, vegetable and mineral kingdoms are admirably represented.

The tortoise furnishes a large proportion of the rich shell used for toilet and ornamental purposes. The pearl oyster abounds on the Buenaventura coast-line.

The breeding of cattle is an important industry, chiefly in the Cauca and Tolima districts, and is rapidly assuming very big dimensions. Cocoa is grown on an immense slope in the Departments of Cauca, Tolima and Santander. The sugar cane abounds in the Cauca valley. Tobacco is very abundant in the North of the Department of Tolima and in Santander.

Indigo, cotton, rubber, vegetable ivory and vanilla are also grown; valuable woods, such as the cedar and mahogany, abound. Coffee and quinine form one of the principal exports of Colombia.

President Reyes is now considering the most effective means of developing the immense region on the Atlantic and the Orenoque, where rubber grows in abundance.

The rubber has been hitherto supplied by half-civilised Indians to the Venezuelan and Brazilian buyers, and, although the territory belongs to Colombia, she derived no benefit whatever from this traffic.

The mineral wealth of Colombia is almost incomparable, all kinds of minerals being found in rich profusion.

The gold and silver mines are almost innumerable, of which only a few are being worked.

Iron is found in abundance in the Departments of Cauca, Santander and Cundinamarca. The Department of Boyacá possesses the best and the most productive copper mines. This metal is also found in large quantities in Cauca, Antioquia, Santander and Tolima. Cundinamarca and Boyacá are rich in lead mines. There are great deposits of coal and sulphur throughout the country. Mention had already been made of the emerald mines of Muzo, in Boyacá Department.

The total production of precious metals from Colombia, from the sixteenth century, is estimated at 3 milliards (£120,000,000), and this with the most rudimentary methods of working. Almost everywhere, and at different altitudes, alluvial gold deposits are found.

The richest gold mines are situated in the Department of Antioquia, which is a veritable golden treasure-house. The Cauca and Santander Departments, although very rich, take a secondary place in comparison with them.

The most important silver mines are situated in the Department of Tolima.

Copper mines are found in Boyacá, particularly at Moniquirá, in that Department. Copper is also found in Cauca, Antioquia, Santander and Tolima.

It is to be remembered that labour is cheap, and that the Government is doing everything possible to encourage railway development. It can, therefore, easily be imagined what splendid results will be obtained when these natural riches are systematically developed.

In conclusion, I would add that the first coupon of the Debt, due January 1st, 1906, was promptly met; that the funds to pay the next one, maturing July 1st, 1906, are already in London; and that the Colombian Government has handed to the Bogotá agents of the Bondholders the Customs bonds for the payment of the arrears of interest. Colombia, therefore, has fulfilled most scrupulously the agreement for the settlement of the Debt, signed in London on April 20th, 1905, between Lord Avebury on behalf of the Bondholders and myself on behalf of Colombia.

FRANCE, COLOMBIA AND PANAMA.

NOTE.—Colombia, in return for an extension of the time granted to the Panama Canal Company, received shares in the New Panama Canal Company, which were left in the keeping of that Company. On the secession of the Republic of Panama, the latter claimed the delivery of those shares—a claim resisted by Colombia, and finally abandoned by Panama. The French Fiscal Authorities then embargoed the 50,000 shares, claiming the payment of registration duties (owing to the production of the documents as evidence in a French Court) amounting to the enormous sum of £544,000. It will be remembered that on the recovery of these 50,000 shares Colombia has undertaken to pay an amount of £70,200 to her Bondholders, being a further 20 per cent. of the arrears of interest.

PARIS, November 15th, 1905.

To the Minister of Finances, Paris.

On my applying to the Ministry for Foreign Affairs I was informed that I should address myself to your Department, in my character of Financial Representative of the Republic of Colombia, for the purpose of laying before you the reasons which my Government has for soliciting from the French Government the release and restitution of the 50,000 shares of the New Panama Canal Company, belonging to Colombia, and in the keeping of the said Company, embargoed by the French Revenue Authorities, for the payment of registration duties. In order to enable your Excellency to form a decision on the matter, I beg to lay before you the following statement.

It is not my intention to give a full history of the negotiations which preceded the present situation of affairs, as that would serve no useful purpose. I will confine myself to a brief résumé of the facts.

Colombia always desired to have the Panama Canal built by a French company. For this there were several reasons, of which I will only cite two principal ones.

1st. The Colombian Government, always fully convinced of the immense international importance of the Canal, wished to treat with a Power offering all the required guarantees of perfect loyalty and respect for signed agreements.

Now, France fulfilled these conditions most exactly; being strong enough to maintain the independence of the Canal, and sufficiently chivalrous not to seek her own aggrandisement at the expense of the sovereign rights which Colombia, and with just right, reserved for herself over the Canal.

The Canal, in the hands of another Power, might have become, at any moment, a menace to the independence of Colombia; and the future will show if Colombian statesmen were right or wrong in the patriotic view of the matter which they placed before everything else.

2nd. The Colombian Government, a faithful reflex of public opinion, has always entertained for France sentiments of a real and deep-rooted sympathy, and, in confiding to France the glorious mission of cutting the Isthmus of Panama, desired to add a new laurel to the high achievements of the Latin Race.

For these reasons, therefore, the Government at Bogotá never refused to grant further extensions of time for the operation of the original concession; and, if the first Canal Company failed, as a consequence of events known to all, the blame for this cannot in any way be laid on Colombia, which has frequently sacrificed her own interests, or has refrained from taking advantage of the rights which the non-fulfilment of the contract gave her, in order to favour the Company again and again by granting further extensions of time.

This attitude of the Colombian Government was cordially endorsed by the whole Colombian nation. It is, therefore, perfectly clear that not the slightest blame can attach to Colombia for anything that has happened.

Having dealt with this point, I shall now proceed to the consideration of matters relating to the restitution to Colombia of the 50,000 Canal shares.

The causes which led to the liquidation of the original Canal Company are now common knowledge.

As I have stated before, Colombia ardently wished that a French company should carry the construction of the Canal to a successful conclusion. For this reason Colombia explicitly stated in every successive contract that the Company was absolutely debarred from alienating or selling the Canal without the consent of the Colombian Government.

There was nothing arbitrary or excessive in the imposition of this clause; and, for the rest, Colombia, as a Sovereign Power, only exercised rights which incontestably belonged to her.

It was also stipulated in the contract that any difficulties that might arise in the interpretation of the clauses of the concession were to be settled by the Colombian Courts, the jurisdiction of which was unreservedly accepted by the Company.

How these signed engagements were respected is now well known, and also what occurred when the concession was sold, but I desire to abstain from comment on those unhappy events.

The original Canal Company, confronted by a thousand difficulties, was unable to comply with the conditions of the contract freely signed by it, and several times was compelled to solicit from the Colombian Government a further extension. Colombia, without the slightest attempt to profit by the misfortunes of the Company, freely granted the delays asked for, without penalising the Company, as it was entitled to do under the terms of the contract.

If, therefore, as since has been most unjustly insinuated, Colombia had at any time desired to eliminate the French Company, all that she need have done was to abide by the exact terms of the contract of the concession, and declare that the concessionnaires had failed to comply with the terms of the contract to build the Canal within certain precisely specified periods, and the contract would have been annulled in a perfectly legal and just manner, and Colombia would have become the absolute owner, *ipso facto*, of all the material and the works already built.

Had Colombia acted in this manner she would have been acting perfectly within her rights, and no one would have been in a position to urge the slightest objection.

She did not act in this manner, she never dreamed of acting in this manner, because of her unvarying desire to help the French Company to construct the Canal. Thus, every fresh application for further delay was granted by her without raising any difficulties.

This conduct on the part of Colombia, ever dignified and loyal, deserves to be remembered, and disproves statements to the contrary made by persons interested in obscuring the truth.

The last extension was granted on December 26th, 1890, to the new Panama Canal Company, which succeeded the original Company.

The capital of this second Company was fixed at 65 millions of francs, divided into 650,000 shares of 100f each (£4), of which 600,000 were to be offered for subscription and 50,000 to be allotted to the Colombian Government according to the terms of the Colombian Prorogation Law of December 26th, 1890.

It is to be remarked that it was the new Canal Company itself, in recognition of the unvarying friendly attitude of the Colombian Government and the granting of the prorogation, which allotted these 50,000 fully-paid shares to the Colombian Government.

If Colombia had not granted the extension, the new Canal Company could not have been formed, and Colombia would have become the owner, under the terms of the contract, of all the material and the works already constructed by the original Company. Colombia, in that case, would have been at perfect liberty to dispose of the concession to some other company, or even to a foreign Government. If, therefore, the Colombian Government had only considered its own interest in the matter, that would have been its natural course of action.

But it did not do so; it did not desire to do so; and in order to once more affirm its sincere wish to assist the Canal Company in every way, granted the prorogation, and left in the keeping of the Company the 50,000 shares which had been allotted to, and were the property of, the Colombian Government.

By this time the events which ended in the secession of Panama from Colombia and the proclamation of the new Republic of Panama are known to all.

The new Republic believed that it could replace Colombia entirely, and consequently laid claim to the 50,000 shares allotted, as I have just said, as a consequence of, and as compensation for, the prorogation of December 26th, 1890. The Republic of Panama wrote to the Panama Canal Company forbidding that company to deliver the shares to the Colombian Government.

Colombia, for her part, applied to the French Judicature for an order to restrain the new Panama Canal Company from parting with the said shares—her effects and property—to a foreign Government, as was explicitly provided for in the Concession Act and the subsequent prorogations.

There was, therefore an action at law, and this brings me to the question of the return of the 50,000 shares.

The Registration Receiver then demanded from the new Panama Canal Company the presentation of the treaties of the concession and the rights enjoyed under same, in order to make them liable for the duties incurred by their production as evidence in a lawsuit, in default of prior registration.

A Law promulgated by Napoleon I. provides that when a contract is produced in evidence in a lawsuit, the appellant or plaintiff is the one who is liable for the payment of registration duties, if these have not been already discharged.

When the new Panama Canal Company sold its concession to the United States in defiance of the formal clause categorically interdicting such a proceeding, Colombia found herself under the absolute necessity of appealing to the French law in order to compel respect for her rights, and there was consequently compulsory presentation of documents.

The new Panama Canal Company was therefore placed in the position of having to pay registration dues to the extent of 13,600,000f (£544,000). The Registrar served orders on the new Company on July 21st, 1904, on the Republic of Colombia on August 3rd, and on the Panama Republic on November 10th, 1904.

This latter Republic, taking a more just view of the matter, abandoned its claim, thus admitting that it possessed no rights whatever over the said 50,000 shares.

Panama raised no opposition to the order, and on January 24th, 1905, gave an unconditional release of the embargo which it had laid on the shares belonging to Colombia, deposited in the keeping of the new Canal Company.

There is, therefore, no longer any litigation pending between Colombia and Panama, the latter having renounced all claim to the 50,000 shares allotted to Colombia as the price of the prorogation of the concession granted by Colombia.

On August 3rd, 1904, the Registrar served an order on the Republic of Colombia, and at the same time embargoed all the sums and other values belonging to the Colombian Government in the hands of the new Company, and specifically the 50,000 shares.

The Colombian Government opposed this claim, and demanded its withdrawal in the Seine Civil Courts on January 30th, 1905.

Colombia, therefore, was absolutely compelled to appeal to the law for the protection of her rights, but is, above all, desirous that the matter should be terminated in a friendly manner.

In view of the treaties and of international law, Colombia is not called upon to defend herself against the claims of the Registrar, and the matter assumes a different aspect.

As a foreign State, Colombia cannot be affected by judgment or embargo.

An absolute point of international law provides that it does not lie in the power of a creditor of a State, even on a judgment obtained against the State, to seize the belongings of that State in the hands of a third party. This law applies when the debtor is a foreign State and the sums or effects seized are in France.

If those duties must be paid, the new Panama Canal Company is liable for this payment, as this Company first had recourse to justice in connection with the concession.

The 50,000 shares belonging to Colombia, in the possession of the new Company, cannot be seized or dealt with in any way, whether by the Registrar or by third parties, because as a Sovereign foreign State she is assured immunity for the effects which she possesses abroad, and notably in France. It is, in effect, a principle of international law, founded on tradition and accepted by all civilised nations, of which one of the direct consequences is that the goods and effects of foreign States and those of their diplomatic representatives enjoy immunity from seizure. This principle may be said to be the fundamental axiom of all treaties, and even of international law.

The natural consequence of this principle is the impossibility of seizing the effects existing in France belonging to a foreign State, as declared by a judgment of the Court of Cassation on January 22nd, 1849.

It is no longer denied in France that the sums owing by a foreign State, or the effects owned by a State, in France, are free from judgment or seizure by a French citizen who may claim, rightly or wrongly, to be a creditor of that State.

In addition, it cannot be claimed that the debts owing by a State to an individual must be compulsorily arranged in the same way as debts between individuals. Each State possesses its own method of settling its debts, which can only be affected by the legislation of that State itself.

To submit one State to the jurisdiction of another State is to violate the principles of sovereignty which insure the reciprocal independence of States.

In jurisprudence this doctrine has been unanimously accepted, and there is not one single instance of a judicial decision upholding a seizure on the part of a French creditor of goods possessed in France by a foreign State.

This principle of the immunity enjoyed by the possessions of a foreign State once admitted and demonstrated, its application in the suit now before the Tribunal of the Seine becomes exceedingly simple.

It is beyond doubt that the Registrar has no right to distrain or embargo the shares belonging to the Colombian Government. It must also be added that Colombia's property in the shares admits of no dispute, Panama having renounced the claim which she advanced to the same.

Hitherto it has been supposed that the Registrar is a privileged person. This hypothesis does not square with the facts. The Registry is the French Government itself, and it is impossible to seriously challenge this proposition.

When the Registrar, therefore, embargoed the shares, this is only another way of saying that the French Government embargoed them.

At the present time, therefore, the situation is the following:—

Colombia is the owner of the shares allotted to it by the Canal Company. The Company, with the object of evading compliance with the terms of the contracts, which lie completely under the operation of Colombian laws, provokes litigation with regard to the shares. Judgment is given in favour of Colombia in consequence of the withdrawal of Panama, whereupon the French Fiscal Department demands the seizure of the shares in order to make effective its claim for registration duties, claimed on a contract signed twenty-seven years ago between the Company and the Colombian Government.

As regards registration duties, these are demanded or not, according to the rules of reciprocity and international amenities.

The seizure of the effects belonging to a foreign State is to-day considered altogether inadmissable, utterly opposed to the canons of mutual respect existing between nations, and dangerous to a sovereign degree. A proceeding of this nature would suffice to compromise neutrality, in case of war, as it would be easy to bring about the loss of a naval or land battle by seizing arms or a vessel of war, on the demand of a creditor.

Without occupying ourselves in a consideration of the right which the French Fiscal Department can possibly have to claim registration duties on a contract for a concession granted twenty-seven years ago, by a judicial act, with an entity which failed twenty years ago, and has been resuscitated under the name of the New Panama Canal Company—without concerning ourselves with this point, I repeat, the question can be decided in favour of Colombia on the ground of private international right.

The general rule, in the case of international right, is, in a word, the just principle of reciprocity. There is, in addition, another rule of public international right, which in the present case should be strictly applied—the principle of extra-territoriality.

As has been just demonstrated, the French Fiscal Department is the French Government.

Is the French Government empowered to cite the Colombian Government to appear before a French Court?

International right opposes to such a pretension the rights of sovereignty of States, from which is derived the general principle of extra-territoriality.

If the representatives of States, their families, their employés and servants are immune from all civil and criminal jurisdiction—if their persons and effects enjoy complete immunity from seizure, the States themselves, with much more reason, should enjoy the same privileges.

Proceedings between foreign Sovereign States with regard to private property are ruled by the prescriptions of international right.

I shall now proceed to refer to various judicial decisions which confirm in an irrefragable manner the justice of the cause which I espouse.

A decision of the First Seine Court declares that the act of seizure of funds belonging to a foreign Government would be a violation of the sacred principles which regulate the dealings of one nation with another, and would be the cause of grave reprisals.

This Court had to decide a most celebrated suit brought by a creditor of the Viceroy of Egypt against this latter, whose effects in France he had caused to be seized.

In defence of the Sovereign, Maitre Odilon Barrot addressed the Court as follows:—

"The person whom you have cited to appear before you, by virtue of a suit brought by an individual, is a foreign Government, for the execution of an act essentially Governmental. Putting the matter in this light is to leave out of the question civil rights and enter the domain of the rights of man. The question to settle, therefore, is whether a foreign Government can be made to appear before a French tribunal to answer for an act performed by it in full sovereignty.

"Such strange pretensions cannot be sustained when one is dealing with the independence of States, of the conditions of sovereignty and the admitted principles of the rights of man.

"No discussion is possible on this point.

"Every writer who has dealt with the rights of man has universally consecrated the principle of the independence of Governments, and has always maintained that the jurisdiction of a State does not extend to the judgment of the acts of a foreign State.

"Jurisdiction is derived from sovereignty.

"In order to recognise the competence of the French Courts it would be necessary to admit that jurisdiction exists independently of sovereignty.

"This is so evident that the Viceroy of Egypt could only admit the right of a French Court to judge him by abdicating his sovereignty."

For the other side (the creditor) it was said:—

"I have caused the goods belonging to the Viceroy of Egypt to be seized at Marseilles. I ask the Court to legalise that seizure. If a prince does business in a country, if he possesses effects or merchandise, furniture, etc., all these things are seizable."

The Court, in accord with the Public Minister, declared:—

"CONSIDERING: That, according to the principles of the rights of man, the French Courts have no jurisdiction over foreign States, save in the question of property possessed by them in France, as individuals, etc.

"CONSIDERING: That the question before the Court relates to a Governmental and administrative act, etc.

"IN THE NAME OF THE LAW, this Court

"DECLARES Null and void the judgment, declares that the Court has no jurisdiction in the matter, and condemns the creditor to pay the costs. (April 16th, 1823)."

Here is seen the perfect analogy between that case and the one I am dealing with. Furthermore, the case of the Viceroy was not so strong as that of Colombia, because the question related to a sum of money which he actually owed, and which he did not deny, whereas the payment of registration duties is demanded from Colombia on a concession which she herself granted in Colombia, to operate in Colombia.

Here is another decision by the same Court.

The question at issue was a suit brought by Messieurs Belguerie against the Spanish Government.

"THE COURT, CONSIDERING THAT Article 14 of the Civil Code cannot be applied to a foreign Government, as this would be to trespass upon the right which every country has to be the sole judge of its own actions; that the matter relates to a public administrative act; that the seizure cannot be upheld, and that the Spanish Government cannot be affected by a sentence of a French Court, unless by a violation of the sacred principles of the rights of man and the provocation of reprisals, etc.

"DECLARES NULL AND VOID the suit brought by Messieurs Belguerie, and condemns them to pay the costs."

The Havre Court, in a suit brought by an Advocate, Maitre Blanchet, against the Government of Haiti, declared that it had no jurisdiction in the matter, because Article 14 of the Civil Code regulates the relations of citizens one to another, and not with States, ordered the release of the seizure effected, and condemned the plaintiff in costs.

To resume, I will further cite the typical case of the seizure made in 1876, in the Port of Antwerp, of cannons belonging to Turkey.

A merchant engaged in litigation with Turkey demanded the seizure of the cannons.

The Court declared that the Turkish Government, not being subject to the jurisdiction of the Belgian Courts, the application for a seizure constituted an attack on international right, against the recognised independence of Turkey, and the usages and customs of society in the relations of one State to another.

The seizure was declared null.

The same law operates in England and the United States of North America.

It is, therefore, clear from international law that the legal jurisdiction of one country does not affect foreign Governments, the chiefs or the diplomatic functionaries, or their families.

The seizure of the effects of a foreign State is considered to be a grave cause of offence, and an act of declared hostility.

The French Fiscal Department ought to have considered, not only the character of the entity whose goods it seized, but also the origin and the nature of the obligation whose fulfilment it demanded.

The origin of the obligation and the obligation itself appear in the contract of the Canal concession.

This contract was signed in Colombia, and contracts signed in a country are subject to the laws of that country, according to the legal axiom, "*Locus regit actum.*"

The Fiscal Department—that is, the French Government—or the Court, in its turn, should have discovered the person responsible under Colombian laws.

Under Colombian laws it is stipulated that the legal interpretation of contracts made with foreigners, and all difficulties that may arise in their interpretation, must be decided by the laws of Colombia.

Apart from this, it is clear that when the question relates to a gratuitous privilege—a concession—the beneficiary is the one to pay any expenses that may be occasioned thereby.

The French Fiscal Department, which twenty-seven years ago did not exact registration duties, but now demands them for a favour granted by the Colombian Government, must find amongst the beneficiaries of that concession the one liable for the payment of those duties.

This is also clearly proved by the tenour of the contract.

The French Fiscal Department has placed a French Court under the obligation of knowing and judging under the laws of Colombia.

If, therefore, the origin of the obligation lies in the contract on which registration duties are now claimed, the nature of the said obligation indicates other persons responsible for this payment—certainly not the Colombian Government.

France has accepted the principle of reciprocity as her guide in international dealings. To abandon this principle in her dealings with Colombia would constitute an act of hostility—a violation of the treaty which unites the two nations, and contrary to a long tradition of friendship.

The law of reciprocity is a French law.

Other nations observe this law in default of treaty obligations for reasons of general equity and for just and rational motives.

This is described by Frenchmen as "droit de convenance," and by Englishmen as the "comitas nationum"—that is, the comity of nations—of international courtesy.

Colombia, therefore, is perfectly entitled to ask from France the application of this law,

1st. Because it is a French law.

2nd. Because Colombia, in a similar case, has acted in the same manner.

All the contracts signed with the Canal Company have been registered at Bogotá, and the Colombian Fiscal Department has not collected a single cent of duty.

3rd. Because France, having agreed to apply to Colombia the most-favoured-nation clause—according to the treaty existing between the two nations—this clause becomes obligatory on France.

4th. Because to deny reciprocity to Colombia in the present case would be to make an exception against Colombia—an exception which Colombia would have done nothing to merit, and which would have to be regarded as an act of hostility.

The law of extra-territoriality takes away from the demands of the French Fiscal Department the essential character of right—its foundation, or effectiveness.

The law of reciprocity takes away its legal basis.

The law of the contract, which is the contract itself, takes away all right of jurisdiction.

Finally, reason declares that this would be contrary to equity and justice.

There does not exist any Court capable of making laws to settle questions between nations.

Extraordinary Courts may be formed for the purpose, but the principle of sovereignty requires that the nations taking part therein should, in some form or other, abandon their sovereign rights by a compromise which explicitly defines and limits the operations of the questions submitted for decision.

These, therefore, become arbitration Courts, and not legal tribunals.

From whatever point of view the question is regarded, the solution must ever be the same—the release of the seizure.

The Registrar, whether a private individual or the State itself, cannot seize the effects of a foreign State in France. But it is beyond dispute that the Registry is the State itself; therefore, it is all the more urgent that, from principles and rights of sovereignty, these effects should be considered as still more sacred and unseizable.

In view of the different reasons which I have laid before your Excellency, I respectfully solicit an order for the release of the seizure of the 50,000 shares in question.

Colombia has always maintained with France the most cordial relations of friendship from the time of her birth as a Republic to the present time, and nothing has hitherto transpired to cloud this friendship, with which Colombia considers herself to be so highly honoured.

It would be to me a real cause of profound grief to be compelled to have recourse to the Courts for the settlement of a question that, in my opinion, ought never to have been raised, and could be administratively settled on the basis of the law of reciprocity.

It is, therefore, with the greatest confidence that I await the decision of your Excellency.

Receive, Monsieur le Ministre des Finances, the assurance of my highest consideration.

JORGE HOLGUIN,
Fiscal Agent of Colombia.

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THE
PANAMA CANAL
AND THE
DAUGHTERS OF DANAUS

BY

JOHN BIGELOW

> *Rusticus expectat dum defluat amnis: ut ille*
> *Labitur, et labetur in omne volubilis ævum.*
> *Epistolæ Horatii I. 2. 43.*

> *He who defers the hour of reform, like the fabled rustic, waits for a river to run dry that rolls on forever.*

SECOND EDITION
REVISED AND CORRECTED

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1908

PREFACE TO THE SECOND EDITION

WHILE the first edition of this pamphlet was in the printer's hands, the announcement was made of Colonel Goethals' intention to suppress the dams recommended by the President on the Pacific side, and with them the so-called Sosa Lake. As the technical reasons were fully ten times more weighty for the suppression of the Gatun dam and lake, I seem to have allowed the reader to infer that the suppression of the one was merely a prelude to a corresponding suppression of the far more reprehensible Gatun earth dam on the Atlantic side, which the President himself pronounced "risky." In this I was mistaken, for it now appears that Colonel Goethals proposes to prosecute that work, though so many times more unstable and insecure than the ones Major Goethals rejected for their unstability and insecurity on the Pacific side of the Isthmus. I jumped too hastily to the conclusion that the Gatun dam in due time would share the fate of the other. This error will be found corrected on pp. 36, 37, 38. I leave it to Colonel Goethals to reconcile a principle of construction which is true on the Pacific side of the Isthmus but false on the Atlantic side, conditions being similar.

THE PANAMA CANAL AND THE DAUGHTERS OF DANAUS

BEFORE the present Federal Congress separates, about four years will have elapsed since the property of the French Panama Canal Company became the property of the United States. The prosecution of that work was then confided by the President, nominally at least, to the War Department. The present time seems, therefore, opportune for a consideration of the progress of this imperial enterprise and to cast our horoscope for the year if not the day when the world will be invited to assist at the nuptials of the Atlantic and Pacific oceans.

On the twentieth of August last, Lieutenant-Colonel Goethals, the present Chief Engineer of the canal, wired the Secretary of War that, "The works scheduled for the fiscal year ending June 30, 1908, can be finished three months earlier—that is, by the thirtieth of next March"; but for that purpose recommends that an emergency appropriation be asked from Congress in time to avert any cessation of construction. The amount of this emergency appropriation, as announced by the Panama Canal Commissioners, is $8,000,000. On the twenty-seventh of August, the Acting Secretary of War wires Mr. Goethals that the President approves of his "creating a deficit" in the manner proposed.

As this document of Colonel Goethals is likely to occupy not a little of the serious attention of Congress, it is given here at length as printed in the "Canal Record," an official periodical issued weekly "under the authority and supervision of the Isthmian Canal Commission."

Secretary of War, Culebra, Aug. 18, 1907.
Washington:

Construction work for this fiscal year is developing faster than was contemplated. Report of expenditures for July shows we are exceeding monthly allowance for labor and have already obligated, very largely, appropriation for material. Results are being obtained in proportion to increased expenditure and with lower unit cost. With present organization and programme, Canal can be completed more rapidly than by keeping within appropriations now available. As compared with last year's appropriation for construction, we have one million dollars less for labor, and the same for material, notwithstanding largely increased demands due to the necessity of starting new work on the Chagres Division, and relocation on the Panama Railroad for which no allowances were made. Work on locks and dams on each terminus has been opened up and should be pushed vigorously this year. Very little was expended at these points last year. *Time of completion of Canal now appears to depend on work at Gatun, progress at Gatun dam dependent on removal of present railroad track to new location. In order to lay concrete in locks next year, plant must be contracted for this year,* but appropriation not sufficient. If in accordance with Revised Statutes 3679, request *authority to continue expenditures in excess of pro rata monthly allowance on account of present necessities and unforeseen developments* since estimates were submitted, with understanding that Congress will be requested to make additional appropriation to cover the deficiency at next session. Additional funds required for construction this fiscal year, four millions for labor and four millions for material; total, eight millions. This is required, not as an increase of cost of Canal, but in order to work faster. If not approved, request to be informed as soon as possible so that work can be reduced and expenditure kept within present appropriations.

Goethals.

I

We now know that at the end of June next, 1908, there will have been expended on the Panama Canal by *our* government	$ 79,608,568.58
As the President has authorized a subordinate in the War Department to approve of the emergency appropriation, it is already being spent whether constitutional or not—	8,000,000.00
which gives a total of expenses to the close of the current fiscal year of	$ 87,608,568.58

The total cost of the lock canal with a summit level at eighty-five feet above the sea, as estimated by the Isthmian Canal Commission in its report of 16th November, 1901, was to be	$144,233,358.00
Deducting from this the generous sum specially allowed for engineering, police, sanitation and other contingencies, of	24,038,893.00
there would remain for expenditures on the canal proper	$120,194,465.00

The same commission in their report of 1901 decided that the canal they proposed could and ought to be finished in ten years, the two years consumed in preparations inclusive.

The canal which was advised by the minority of the consulting board assembled in Washington in 1905 by the President, and which the President recommended, is also a lock canal, with a summit level at eighty-five feet above the sea. It differs from the canal of 1901, on the plans of which the construction was begun in May, 1904, by a different location of the dams and locks.

It has been stated that the time and cost of construction would remain practically the same for both forms of canal. It has been also stated that all the works made prior to the modification of plans were also useful for the new plans and that no time nor money would be lost by this modification. Therefore we are entitled to depend on the original figures relating to cost and time in order to judge the results actually obtained.

Four years plus two months will have elapsed on the thirtieth of next June. On the Isthmian Canal Commission's estimates the following will be the proportion of expenditures that should have been incurred and work done for the completion of the canal within the promised period of ten years:

As the expenses for sanitation, engineering, police, etc., must largely be made in proportion to the time lapsed, four tenths of $24,088,893, say $9,600,000, ought to have been spent on that account next June.

This would leave at that date a total expenditure of $78,000,000 for the works alone.

This sum represents exactly six and a half tenths of the total sum of $120,000,000 provided for the works.

Colonel Goethals asserted in his telegram that his request for more funds did not mean an increase of cost of the canal above the estimates. He must, therefore, be prepared to show to Congress that at the end of June next:

First. Six and a half tenths of the Gatun dam across the valley of the Chagres River, or 5000 feet of its length of 7700 feet—in other words considerably more than half—had then been built.

Second. That nearly four of the six huge twin locks to be provided should then also be complete and ready for ships and commerce.

Third. That of the remaining 54,000,000 of cubic yards of excavation left by the French Company to be made, 35,000,000 cubic yards should have been excavated by our engineers.

We will now turn to the "Canal Record" to ascertain what portion of this work has been done or will be done two months after the expiration of the fourth year of our management of it.

First. Of the six and a half tenths of the Gatun dam to be built, thus far not a load of stone or a shovelful of dirt has been contributed to it. It is of this work that Mr. Goethals said in his reported application for an emergency appropriation just quoted, that "the time of the completion of the canal now appears to depend on the work at Gatun, not on the excavation of the canal."

Hitherto the Culebra cut and the control of the Chagres have been the lions in the path of this canal. This rashly projected dam is now for the first time presented as a terror more formidable than either of the others, and the work of subjugating it is not yet begun. We learn by the "Record" of September 18th that "*it is hoped to start* the construction dam before the first of January."

Second. Four of the six huge twin locks required should be nearly ready for use within less than half a year, according to the money spent. Yet not a block of stone has been cut for one of them. According to the "Record" of September 4th, "It is believed that the actual masonry work can be commenced at the Gatun locks within eighteen months"—that is, the first stone may possibly be laid in March, 1909. So recently as the twentieth of October last, the Canal Commission submitted to the Secretary of the Navy the question of widening the locks, so that it is doubtful if even the plan and dimensions of the locks can be settled before February, 1909.

Third. Of the 54,000,000 cubic yards of excavation in the Culebra hill, upon which most money has been spent and the Government's force ought to have been concentrated as exclusively as practicable from the beginning, at least 35,000,000 should have been removed in June, 1908. Of this, however, but 7,812,186 cubic yards had been removed at the end of June last. It is now apparent that there will not have been extracted on the thirtieth of June next, according to the average yearly output, but at the most about 17,000,000 cubic yards; barely one half of the output which the money expended requires. Even this small output has been obtained for the most part in simply widening, without deepening the cut as left by the French Company. Indeed, the public has no evidence that the cut has been deepened an inch. When Colonel Goethals begins to deepen the cut he cannot expect to maintain even his present moderate output, except at a prodigious increase of expense, for every foot the trench is deepened, the greater the risk of slides and the accumulated volume of torrential rains which unsettle the roadbed almost as fast as the rails can be replaced.

At the pace of expenditure during the present fiscal year of $34,000,000, following an expenditure of $26,000,000 last year, it would not be safe to reckon upon an expenditure of less than $40,000,000 a year in future; which means that by the autumn of 1909, or say scarcely a year and a half from the thirty-first of June next, 1908, the total sum which the Panama Canal was estimated by the President's engineers to cost, will have been expended, and certainly less than one third of the projected work completed.

II

IT deserves to be remarked that the expenses incurred on this canal have not been swollen, as in the case of a private corporation, by brokers' fees, by interest on capital, by costs of advertising or commissions of any kind; that it was not confronted at the beginning, as the De Lesseps Company was, by a virgin forest. On the contrary, the whole line of the canal was studded with workshops, dwellings, much costly material, roads of access and service, not to speak of an enormous collection of technical documents of great value. Besides, it was equipped with the prophylactics with which modern science has armed the canal-diggers, since the beginning of this century, against the malignant fevers with which the French Company had constantly to contend; yet, with all these advantages, physical and financial, enjoyed by us, we are forced to the humiliating admission that the De Lesseps Company, the life of which terminated so disastrously for its stockholders, spent considerably less money for the work accomplished than we have done. During the eight years of their control of the canal, from the third of March, 1881, to December, 1888, their average annual expenditure for the work done was twenty millions of dollars to execute seventy-two million cubic yards of excavation in seven years and nine months. Our Government between the moment it came into the possession of the French property and March last, have spent an annual average of sixteen millions of dollars to execute in two years and eleven months only six million cubic yards of excavation—a difference which shows that the French Company on an average had about four times more return of work for the money spent than our Government had in that time.

President Roosevelt, in his Message of December, 1906, and shortly after his return from his naval promenade to Panama, stated: "The French excavating machines, though of excellent construction, are mere toys when compared with the new steam shovels, just as their wagons for removing the excavation resemble the toys of children when compared to the long trains of platform cars which empty themselves that we employ." He adds: "In the season of rains our steam shovels cannot do much in the movable earth, but they work constantly in the rock or in the hard ground."

The President could apply to the enormous cars what he says of the steam shovels, and add, that in excavating the movable earth they would regularly be off the rails instead of on them. If the French Panama Company had as recklessly measured the weight of its locomotives and cars by the greatness of the cut, regardless of the ground and the rains, by adopting the American machinery which first took its place, it would not have done anything during nine months of every year. The President himself admits that these machines do nothing in movable earth during rains. Most of the trenches at the time of the French occupation were of soft clay, while the Americans' work of to-day has been for the larger part in hard clay and rock.

The President evidently did not take sufficient account of these facts or he would have hesitated to compare to toys the mechanical system which, twenty years ago, excavated, with half the number of men than are now employed, in the three last years of the old Company's existence 1,400,000 cubic yards a month, while the so-called superior American machinery now employed, at a quadruple expense, had given as a maximum up to the time of the President's message but a cube of 325,000 cubic yards per month, or less than one third of the cube officially announced in April previous by the President of the Isthmian Canal Commission as the expected monthly excavation of the second half of 1906—1,000,000 cubic yards.

In the three days the President spent on the Isthmus he was naturally too much occupied with the festivities awaiting him to inform himself that there were at that very time one hundred French locomotives *toying* in the canal, while only thirty-nine American ones were "making the dirt fly"; that there were also at the same time 541 French dump-cars toying for the children of the Zone, and but 324 genuine dirt-flying American dump-cars.

Had his Excellency, when crossing from Colon to Panama, felt as much interest in the subject as he exhibited a few weeks later in his Message to Congress, and consulted the Superintendent, he might have learned that there were at that very time exactly as many French as American locomotives—twenty-four—operating the railway on which he was riding.

While on this subject, it may be well to call the reader's attention to the recent resurrection of "a French elevator dredge which had been lying," according to the official "Canal Record," in the Rio Grande above La Boca for more than twenty years, and for $20,000 "has been restored in every part so that it is now capable of excavating 120,000 cubic yards of material per month, an amount equivalent to that removed by four ninety-five-ton, five-yard steam shovels. This dredge," the "Record" adds, "when in service at the La Boca entrance of the canal will do more work than a modern dipper-dredge costing $102,500. . . . The engine which had remained in the jungle near Sam Pablo for more than twenty years was in excellent condition and could not be surpassed by modern machinery, both as to adjustment and economy of operation. The copper piping on all the machinery is of very heavy design and shows much more careful workmanship than is found in modern machinery. The remarkable preservation of this machinery was due in the first place *to the high quality of the material used* in construction, and in the second place to the use of white lead and grease which excluded the air."

Referring to this dredge, in the "Record" of October 9th, it says:

> "Her performance is even more satisfactory than was anticipated. The engines and transmission machinery run smoothly, the control is simple and effective, and the consumption of coal economical for the power developed. . . . Owing to the long haul, the mud barges working with the dredge *are unable to dispose of all the material that could be removed by this machine.* Arrangements are being made to add new barges to the fleet. *One French barge has been re-built and the work of overhauling another has begun.* When this shall have been done, the output of the dredge will be considerably increased.
>
> "Another old French dredge of similar type is now being repaired in the Crystobal dry dock, and will probably go into commission about the last of October."

We have been waiting nearly four years to discover that twenty-six years ago the French employed dredging machines superior to those we have provided. Now we see, if we consult the recent report of the Isthmian Canal Commission for 1906–1907, what our dipper-dredges have proved their capacity for doing.

On page 50 we find that:

> "The new five-yard dipper-dredge, similar to those ordered for the Colon dredging division, was accepted, and commenced operation at noon, May 20, 1907, in the channel in the vicinity of the wharf [La Boca]. From May 20 to June 30 it was operated twenty-two working days, during which time it excavated 22,300 cubic yards of material."

In the same space of time one old despised French dredge would have excavated 150,000 cubic yards, say about six times what our so-called "modern dredge" could do.

So recently as the twenty-fifth of December the "Canal Record" reports, "Work was continued on ten old French locomotives and fifty old French dump-cars in order to put them in condition for service."

And yet more recently, on the first of January, the "Record" tells us that "The Sanitary Department has recently called the attention of the Chief Engineer to two seventy-five-ton coal-barges lying in the Rio Grande where they had been *abandoned*. These barges are in fairly good condition and can be economically rebuilt. It is thought it will not be a difficult matter to float them out during high water in the river.

"Because of the special design of these old French barges they have the same advantages as ships built with a double bottom, and are structurally very strong and practically unsinkable. The space between the bottom of the barge and the bottom of the hold, with the lateral bulkheads, forms airtight compartments, so that if a hole were knocked in the hull by a collision, or even if the hull itself were cut in two, the barge would float. This feature of construction has proved its usefulness on several occasions."

The ignorance of our engineers about dredging soft ground is still darker when the question of dredging hard ground comes.

The September excavation of 1907, reports Mr. Goethals, was the largest which had then ever been made—1,481,297 cubic yards. Unfortunately, of this output 403,852 were dredged in Colon and 144,625 in Panama—in all 548,477, not in the Culebra but in the low and marshy levels of the coasts, and, like so much of the two previous months, may, part or all, have to be handled again for the construction of the dams, or be wasted, leaving the Culebra output for this month but 763,286 cubic yards.

Could the whole of the output be credited to the Culebra, it would still be ridiculous to treat the result as a triumph over the old French Company, as the organ of the Canal Commission persists in doing. The latter achieved their average monthly output of 1,400,000 during 1886–1887 and 1888, with but 15,000 operatives; we, for a feebler average, with practically little if any yellow or Chagres fever to war upon, with sea-going suction-dredges propelled by twin screws costing without their equipment over $362,000 apiece, had about 40,000 men on our payroll.

It may here be remarked parenthetically that the Ancon, which is the name of the first of these powerful and costly dredges, has been employed ever since its arrival at the canal entrance in Limon Bay, not in the Culebra cut, and when loaded, steams out to sea to discharge its cargo off Toro Point. The others by this time are doing the same kind of inopportune and wasteful work.

It will be many years—six at least—by the rate it has been progressing, before the bottom prism of the canal will be cut to the level of forty feet above the sea in the Culebra in order to obtain a water level at eighty-five feet. I apprehend it will be no easy matter for those who ordered this expenditure of $1,086,000 for suction-dredges to explain to the satisfaction of Congress why they were ordered so soon, or when ordered they were set to work when and where it was impossible to utilize their output. Of course, the policy of protecting our infant industries requires that no money should lie in the Treasury long enough to prompt the plain people to ask whether some of their taxes might not be lightened by a reduction of the tariff; but that not being one of the policies for which the Washington Government stands at present, are there not plenty of other uses for our accumulating millions, from which the country some day might derive some advantage?

If, as the scientists say, dirt is matter out of place, then these costly machines are in a dirty business, the more dirty because the only other apparent motive than the one just referred to for dredging Limon Bay at this time is to swell the amount of output and mislead Congress and the public about the value of what is really being done at the Isthmus.

The only excuse I have for dwelling thus long upon the comparative achievements of the French and the American canal-diggers on the Isthmus is that, from the very inception of the work by our Government, it has manifested a fear that there would not be glory enough to go round if any credit whatever was conceded for what, during their many years' occupation, the French engineers had done toward proving the practicability of piercing the Cordilleras by an oceanic channel.

It will be hard to persuade any person who knows Colonel Goethals that either he, or any officer of his rank in the American army, would, of their own motion, have diverted men and machines from the work where most required merely for the ignominious purposes of imposing upon and obscuring the judgment of the legislative branch of the Government. No one knows better than they also that it is no part of the business of a Government commission to vaunt the superiority of its engineers over any others, foreign or domestic, even when they shall have demonstrated the fact, which this Commission has not yet done, nor shown any likelihood of doing. Nor is it their business to cook canal statistics in a way to disguise either their lack of skill or their extravagance, but to build the canal as expeditiously and inexpensively as possible—precisely that and nothing but that. This nation is building a canal to facilitate the commerce of the world and to multiply its industrial resources, not that we may taunt the French for not accomplishing twenty years ago what they failed to accomplish only for lack of the Government support to which it was justly entitled, while our Government at that very time was making efforts for another Isthmian Canal which, but for the Herculean efforts of a French engineer, would have proved infinitely more disastrous to us than the French Company's collapse proved to them. What that Company had actually done for a canal we thought worth to us, and gave $50,000,000, in addition to the proof which they and they only could furnish, that the Panama route was the only practicable trans-continental canal route. Nor must we ever forget that but for a French engineer's superior judgment and active interference, we would have now been embarked upon another canal enterprise upon which we would have spent hundreds of millions before discovering that it was stillborn and could never be trusted to take on its bosom a ship or a steamer.

And now my readers, if any are so patient as to have followed me thus far through this dreary Serbonian bog, may be provoked to ask if we are to despair of having a trans-continental canal, or are we to be bankrupted in digging it? To these questions I answer that I do not despair of our having a stable, ample, and permanent canal, but not in this generation, if even in the next, unless prosecuted by other methods than those recommended by the President and by which it has been and is still operated.

I must here be indulged with some reminiscences which will explain, and I hope may excuse my meddling publicly with problems the solution of which are usually and properly supposed to belong exclusively to professional engineers.

III

In the month of February, 1886, in response to an invitation addressed by the late Count Ferdinand de Lesseps, the projector and the President of the Panama Canal, to the Chambers of Commerce of the maritime world to meet him at the Isthmus and inspect the progress of the great enterprise he was then prosecuting there, I accepted an invitation from the New York Chamber of Commerce to act as its representative on that occasion. I had been upon the Isthmus but two or three days before I realized the necessity of asking President de Lesseps if he could not put me into communication with some officer to whom I might with propriety apply for such information about the works as I required, without troubling him. The Count was no longer a young man; like myself he was not an engineer nor of course familiar with the details about which I was seeking light. "Certainly," he replied, "I will present to you the best man for your purpose that we have. He knows more about the canal work than any one else on the Isthmus." Presently, and obviously at his behest, a young gentleman approached and was presented to me. In presenting him the Count said to him with some emphasis, "Mr. Bunau-Varilla, you will please give Mr. Bigelow all the information he asks of you about the canal, without any reservations whatever," or words to that effect. The following morning I submitted to this gentleman, with whose name the world is now familiar, a series of questions which I had prepared on my voyage from New York, remarking at the same time that it would be a better economy of his time as of mine, for him to take the questions and underwrite his answers during his moments of leisure, than for us to sit down together to the work; for I saw that he was a very busy man, though I did not then dream, what I afterward learned, that he was only twenty-six years of age, and at the time was not only Engineer in Chief of the whole work, with from ten to fifteen thousand men under his command, but had the exclusive charge of the forty or fifty delegates who were to be slept, fed, transported about the Isthmus, and individually enlightened in regard to a complex system of works of which few of them could boast, more than myself, of having even an elementary knowledge. I did not then, nor until some three months later, learn Mr. Bunau-Varilla's age or official position and importance. Shortly after the guests of Count de

Lesseps left the Isthmus, Mr. Bunau-Varilla had been stricken with the country fever, a by no means surprising result of the accumulated cares that had been heaped upon him, in addition to those belonging strictly to his official position, and after narrowly escaping with his life he took a sick leave and returned to France for a change of air, nursing, and rest, calling upon me in New York on his way, his place as Chief Engineer being filled by Mr. Boyer.[1]

My acquaintance with Mr. Bunau-Varilla, thus renewed in New York, it has been a great pleasure I think to both of us ever since to cultivate; and I have thereby been qualified to give some particulars about his antecedent as well as subsequent life which is likely to make his name as enduring in American history as that of any other man of foreign birth.

Born in Paris in July, 1859, he graduated as Engineer of the *Corps des Ponts et Chaussées* in 1883; was detailed by the French Government as Engineer *des Ponts et Chaussées* in Tunis and Tripoli from May to September, 1883; again at Bayeux in France from September, 1883, to October, 1884. He was then sent by the Panama Company as Engineer in Chief of one of the three divisions on the Panama Canal from October, 1884, to April, 1885, taking, at this time, command of two of the three divisions of the canal, and in September, 1885, after the departure of Mr. Dingler, the Engineer in Chief of the canal, he was selected, as the fittest man then in the service of the Company, as his successor.

During his absence on sick leave the contractors for the excavations in the Culebra cut failed. As this cut was regarded and still is quite the most serious physical obstacle the Canal Company had to contend with, Mr. Bunau-Varilla, on his return to Panama, was requested to form a new company especially to prosecute that work.

Though the effect of this change was to separate Mr. Bunau-Varilla from the staff in September, 1886, he cheerfully accepted it. Before a year elapsed in his new position the difficulties he encountered from the torrential rains at the Isthmus in getting rid of his excavation by rail were so serious and costly that he became satisfied that some new method must be devised. Taking a hint from the greater cheapness of transportation by water than by land, well known to engineers, he began some experiments in artificial pools or lakes with dredges and tugs. He at length satisfied himself that excavation by a floating dredge, to be towed by a tug where its contents could be discharged promptly and at little expense automatically, would put an end to many of the difficulties to which the previous contractors had succumbed; that there would be no further need of the army of workmen to be constantly changing the rails as the excavation progressed, nor of workmen to watch and adjust the track, which could be neither firmly placed nor properly ballasted to long endure the use required of them. By this device he apprehended no further serious difficulties in contending with the frequent tropical deluges which cover and bury the rails with the detritus washed in from the walls of the trench; no more of the incessant derailings of cars which the incurable conditions of the soil and climate make inevitable, blocking often for weeks all communication between the points of loading and of discharge, leaving hundreds, if not thousands of men unprofitably idle or employed in repairing wreckage.

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[1] Mr. Bunau-Varilla's immediate predecessor as Chief Engineer, Mr. Dingler, had himself resigned and returned to France, broken-hearted by the loss of his wife and all his children from the malignant fevers of the country. Bunau-Varilla's successor died of the same disease in the month of April of the same year.

While thus experimenting with floating dredges, though still in a small way but encouraged by its success, he conceived the idea in 1887 of a temporary high level lock canal to be later dug by dredges floating on the water supplied by the Chagres River.

His plans were adopted and executed from the beginning of 1888. The financial collapse of the Company however, at the end of 1888, terminated his connection with the work. Had he been permitted to continue in charge of the work, he had counted confidently upon having the first navigable level across the Culebra cut established at the 170-foot level, and to thus open the canal for traffic in 1891.

IV

WHEN, during Mr. McKinley's administration, our Congress seemed determined to pledge the credit of our Government in favor of an Isthmian Canal through Nicaragua, a bill for that purpose having passed the Senate both in January, 1895, and

1898, with only few opposing votes, and with no opposition from the Executive, some prominent gentlemen from Ohio met Mr. Bunau-Varilla by chance at a lunch in Paris at the time of the Exposition, and this disposition of the Washington Government became naturally a topic of conversation. As naturally it led to Mr. Bunau-Varilla's exposure of the folly we were in danger of committing. The merits of every imaginable canalizable pass in Central America had been more exhaustively studied by Mr. Bunau-Varilla for the De Lesseps Company than it had ever been studied before or since, and he had published a book in 1892 on the Panama and Nicaragua canals.

But a few months after this conversation, Mr. Bunau-Varilla received a note from one of the guests at the Paris symposium asking him if he would not come over and address a body of leading engineers and business men, who would be invited to meet him, on the subject of the relative merits of the Nicaragua and Panama routes for a trans-continental canal. Mr. Bunau-Varilla promptly notified the writer of his acceptance of the invitation. In less than a month, in January, 1901, he was heard in Cincinnati by a select audience, invited by the Commercial Club of that city. He was the same evening invited to address an audience, composed exclusively of engineers, on the same subject, at Cincinnati, and then at Cleveland, at the request of intimate friends of Senator Hanna. Subsequently, with brief intermissions, he responded to similar invitations from Philadelphia, Boston, Chicago, and, finally, from the Chamber of Commerce of New York. One of the results of these conferences was that at the following session of Congress the Nicaragua route was almost unanimously abandoned by both houses, for the Panama as the most desirable route. As a consequence of this change of public sentiment in Washington, the Colombian Government coöperated with Mr. Hay most zealously, and directed its diplomatic representative at Washington to negotiate a treaty to that effect, which was formally signed by the official representatives of the two governments.

When it became known at Bogota, however, that we were willing and had actually agreed to pay $40,000,000 for the property of the French Company, whose charter had but one year more to run, if a debatable prorogation of six years was not enforced, the Colombian Government refused to ratify the treaty. The object of this strange behavior, avowed by members of the Colombian legislature, was to await the expiration of the French charter, refuse to adhere to the prorogation, then confiscate the whole property of the French Company on the Isthmus, and appropriate the $40,000,000, or perhaps a larger sum, if a larger could be extorted, to their own use. Our Government, so long at least as John Hay was Secretary of State, could be a party to no such iniquity; neither were the people of Panama willing to risk the possible and even probable adoption of the Nicaragua alternative, which had many allies with large pecuniary interests staked upon its adoption. The result was the determination of the people of Panama to sever their political connection with the State of Colombia, and, following our example of 1776, proclaim their independence.

Having been kept by Colombia always impoverished to the last degree, and finding themselves unable to organize any effective defence of their independence if contested, for want of means to pay for weapons and soldiers and ammunition, a committee of three or four of the leading citizens of Panama—one of them the first and present President of the State of Panama—then repaired to the United States, where they had, of course, the best right to expect it, for financial aid. Of course they sought Mr. Bunau-Varilla, who chanced to be then in New York, and with whose previous history in Panama they were familiar and whose service to the canal they appreciated. Knowing full well the aggravating nature of their grievances, he lent them, without hesitation, $100,000, which he placed to their credit with the banking house of J. P. Morgan & Co. of New York. With that equipment fund the Panamanians were able to put themselves so far in a defensive position that the Colombian Government did not think it prudent to attempt seriously to disturb it. They realized that they had imitated the foolish dog which lost the beef in his mouth in trying to secure what he supposed to be another piece reflected in the water he was crossing.

The people of the United States have always thought it a fine thing, and one which every American minister on being accredited to the Government of France is accustomed to refer to in laudatory terms, that Louis XVI lent us a few millions to maintain our independence in 1776. But King Louis lent his people's money, not his own. Mr. Bunau-Varilla lent his own money and at a far more serious risk.

Under any dynastic government in Europe the conduct of Colombia in refusing to confirm a treaty which she had successfully used every means available in diplomacy to induce a friendly Government to sign, would have been regarded as an ample justification for an appeal to the last argument of kings.

We were thus and still remain indebted to Mr. Bunau-Varilla, not only for rescuing us from the disastrous folly of attempting a waterway through Nicaragua, and for the independence of the State of Panama, but for what is more immediately and specially important to us, for drawing with his own pen the treaty known to history as the Hay-Bunau-Varilla Treaty, which secured to us privileges of incalculable importance for the prosecution of our great national and international enterprise of which the State of Panama is to be the theatre; privileges the value of which at some future day will be more fully realized than they are at present.

V

THE Hay-Bunau-Varilla Treaty with the new Republic of Panama was signed in November, 1903, and ratified February, 1904. The Isthmian Canal Commission, of which Admiral Walker was the first President, was recast and converted into an Executive Committee of Construction, and men ranking as eminent engineers were selected from different States for this Commission. Mr. Wallace was sent to Panama as Chief Engineer. Scarcely a year elapsed however before this Commission was dissolved, their efficiency as canal-diggers having failed to commend itself to the President or to themselves. An entirely new Commission was appointed, and Mr. Shonts, the president of a western railroad, was placed at its head, Mr. Wallace remaining Chief Engineer and becoming a member of the Commission. This was in April, 1905.

In the course of two or three months, Mr. Wallace, failing to accomplish what he had thought easy, resigned, and was publicly abused as a coward by the Secretary of War. Mr. Shonts then recommended the importation of Chinese workmen, and that failing as contrary to law, he recommended the letting out the digging of the canal to contractors, but upon terms which made illusory all advantages of the contract system. Both his recommendations failing, and the cube of the output in Culebra remaining one third of what he had publicly announced it was to be, he followed Wallace's example at the risk of being similarly stigmatized by Secretary Taft as a coward, and he also resigned. This was in January, 1907. Mr. Stevens, the Chief Engineer under Mr. Shonts, was then appointed to succeed him as President of the Commission. A month had scarcely elapsed before he braved the risk his predecessors had successively incurred, and resigned. It then became necessary for Secretary Taft to find a man who could not resign. He had tried the Navy, but Walker was a retired officer who could only be punished by calling him names. So he took an engineer officer from the Army who could not resign without greater personal sacrifices than army officers can ordinarily afford to make, especially when the code of honor does not require a cabinet minister to accept a challenge from a subaltern.

During these three years none of the several executive officers tarried scarcely long enough at their post to become informed of the number of men they had under pay and where they were severally at work. Of course the function of the Canal Commission seemed smothered in surmise; to be pursuing policies which kept the Government at Washington constantly on the defensive, "continually picking slivers out of their own shins."

Sensible of and deploring the President's embarrassment, Mr. Bunau-Varilla addressed him two letters setting forth what he deemed the errors which his engineers had been making from the outset, and by adherence to which he apprehended that the canal would not be opened for traffic in less than twenty years if a sea level canal was contemplated (as the President had in mind in the beginning of 1905), nor for three times the money which his engineers had estimated it would cost. In these letters he also explained how the canal might have been opened for traffic in four years and at a cost inferior to the original estimates of the canal at eighty-five-foot summit level. These letters were dated: the first, twenty-sixth of September, 1905, and the second, the twenty-ninth of October, 1906.[1] These letters cannot be too carefully conned by those who are officially responsible for the millions that are now being spent under what is obviously a pernicious system.

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[1] These letters we find at length in a brochure recently published in Paris by M. Bunau-Varilla entitled *Le Détroit de Panama—Documents relatifs à la Solution Parfaite de Probleme de Panama.* Dunod et Pinat, Publishers. The pertinent passages of both these letters will be found in Appendix A and Appendix B.

The vital features of what the distinguished French engineer terms the perfect solution of the Panama problem were:—

First. By dredging the contemplated prism of the canal instead of excavating it.

Second. To this end building on each side four locks for reaching the summit through the Culebra cut, the level of the water being not lower than one hundred and thirty feet above the sea.

Third. Constructing two dams, one at Gamboa of steel concrete, and one at Bohio of earth, but very low and narrow. Both these dams are across the Chagres on the Atlantic side of the Isthmus. With these dams to collect sufficient water, not only to navigate the canal but by its power to supply all the electrical energy required for lighting, for driving all the machinery, for dredging and for transporting the excavation, thus making an alliance with natural forces instead of contending with them. All the hard labor to be done practically, after the construction of the first high level lock canal, by electricity, of which the Chagres would furnish an inexhaustible abundance, while the officers and men conducting the dredges, scows, and tugs would be sheltered both from the rain and the sun, exposure to which are the chief perils of the Isthmian climate.

Fourth. No railway track, cars, or locomotives to be required for the removal of much if any of the excavation below the first water levels connected by locks, the highest one being the 130-foot level.

Fifth. By dredging under water little or no regard would need to be paid longer to the question whether the dredger encountered rock, gravel, or mud, science having provided our generation with machinery for dredging rock even cheaper under water than above it.[1]

The first Isthmian Canal Commission in its report of 1901 fixed the expense of extracting submerged rocks at about $4.75 a cubic yard. Mr. Bunau-Varilla directed the President's attention and that of his engineers to a modern process of rendering the rocks dredgeable at a very greatly reduced cost by the Löbnitz system, as it is called,[1] which was invented to meet the exigencies of the Suez Canal some eighteen or twenty years ago. By that system, now quite familiar to the Old World, though apparently unknown to the President's engineers, the rock work was done for the Suez Canal at the rate of fifty cents a cubic metre, or less than one tenth the price at which the engineers estimated the price by its familiar methods. The rock dredging on the Suez Canal cost fully twice what it would cost at Panama or would have cost in Egypt but for the interruptions of the work by the frequent passing of vessels and by the long distances to which the excavations had to be transported. Mr. Hunter, the Engineer in Chief of the Manchester Canal, is reported as announcing in 1905 before the President's Consulting Board of which he was a member, that several hundred thousand cubic yards of rock, harder than any encountered on the Isthmus, were going to be taken out of the Manchester Canal to give it a depth of twenty-nine feet by the Löbnitz method, and that the cost was rated a little less than fifty cents a cubic yard, which is the price of the excavation in the dry. This gentleman since then has published in the "Engineering" of the seventeenth of August, 1906, a note about the actual price of this mode of rendering rock dredgeable under water and removable by dredges. It was, after ten months' experience, eighteen cents a cubic yard. In June, 1907, before the Institution of Civil Engineers in London, Mr. Hunter declared that the average cost after completion of the works had been twelve cents per cubic yard for making the rock dredgeable. If we add ten cents for dredging and transporting, the price does not reach twenty-five cents per cubic yard, say one tenth of the price fixed by our Isthmian Commission in 1906, and one nineteenth of what it admitted in 1907 as the standard price.

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[1] See reports and discussion before the June Conference of 1907 Institution of Civil Engineers—London Transactions of Section II.

These low prices of rock dredging are confirmed by the results in many other large maritime works of the Old World, including those of the empire of Japan which has purchased seven of Löbnitz's rock-dredging plants from 1900 to 1905.

In the process of the investigation before the President's Consulting Board, Mr. Wallace, the first Engineer in Chief of the Panama Canal, testified as follows:

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[1] A system by which a column or shaft of steel with a movable point may be made to descend upon the hardest rock and crush it in pieces of the size of a man's hand, when it becomes entirely dredgeable.

"As to the excavation of rock under water there is *a process of which there has been no question in any of the reports,* but I think that Mr. Bunau-Varilla has referred to it. It is the process which consists in breaking rock by what they call the hammering system."

MR. HUNTER: "You mean the Löbnitz system?"

MR. WALLACE: *"I do not know how you call it."*

MR. HUNTER: "You need not dwell on that subject; we have discussed this in the Commission fully. It is a process with which both Mr. Quellennec and I are very familiar."

Mr. Quellennec was a member of the Consulting Board. He had been selected on account of the distinguished position he held as Consulting Engineer of the Suez Canal. It is a curious circumstance that Mr. Wallace, the first Chief Engineer of the Isthmian Canal, had never heard and did not know the name of the Löbnitz system, and still more remarkable that in the official report made by the Consulting Board there is no reference to the subject of the Löbnitz system, although Mr. Hunter, the chief engineer of the Manchester Canal, says: "We have discussed this subject at great length. Why it was excluded it is difficult to surmise, unless the resident engineers knew nothing about it, or the millions of money and the years of time saved by its use in the construction of the canal were not worth saving. By this process there would be no loss of time, as by the dry haul, where, during the rainy season, thousands of men may be left idle while a train or an engine is being extricated from the mud into which the railway track has been sunk or washed away. Nor would there be any corresponding expense for relaying the track every three or four feet that the trench is deepened. In fact, the dredge would almost completely supersede the services of the railway while the men would be protected from sun and rain."

An objective lesson of the advantage of this wet haul has quite recently occurred and was thus first reported in the "Canal Record" of October the ninth:

> "Owing to the heavy rainfalls of the past few weeks, the Cucaracha slide which remains quiet during the dry season has again begun to move. It remained practically quiescent during the entire period of control of the new French Company. With the resumption of work by the United States in 1905, the slide again began to move and has continued to give more or less trouble during

every wet season since. The total amount of material in movement is estimated at about 500,000 cubic yards. The movement during the present season has been more rapid than usual and the berms have been filled up, permitting a part of the material to get into the canal prism. Shovel No. 223 was caught by the moving mass of material on October 4th and was extricated unimpaired on October 6th. Shovel No. 109 was also caught, but was pulled out by wrecking train on October 5th."

In the succeeding "Record" of the sixteenth October we read:

"The work of removing the material cast into the Culebra cut by the Cucaracha slide has continued without interruption day and night since the last issue of the 'Canal Record,' and several hundred cubic yards of material have been taken out. To avoid delaying the movement of the dirt trains a track is being laid from the bottom of the cut up to the second level on the west side. This track will be completed in about a week, and when finished the movement of dirt trains will cease to be affected by the slide."

Here we have a slide of 500,000 cubic yards, part of which went into the prism of the canal, and the rest so occupied the track as to delay or obstruct the movement of dirt trains more or less for the succeeding two months at least. Two shovels were caught by the moving mass which it took two days' labor to extricate. A new railway track had to be laid which was to take two weeks to construct, and meantime we can only guess how many men are to be withdrawn from the canal work proper and for how long a time. By the "Canal Record" of November 6th we learn that the work in the Cucaracha slide "has been aided by the slow movement of the slide which has dropped from fourteen feet a day, the rate maintained during the first two weeks, to about four feet a day. Two tracks have been laid past the foot of the slide, and the third track (three tracks instead of one) will be laid in a few days. The movement of dirt trains to the full capacity existing before the slide will then be resumed."

In the same "Record" of November 6th we are told that the total excavation during October was 1,868,729 cubic yards. Of this grand total of excavation, it adds, 826,891 cubic yards were from Culebra, while the total by dredges was 766,754 cubic yards,—409,632 of these at Colon and 357,122 at La Boca. On accessory work outside the canal prism, 24,258 cubic yards were taken by dredges, by which it appears that 791,012 cubic yards, or more than half of the reported October output, were not taken from the Culebra division but from the low levels at the extremities.

During a period now of entirely six weeks at least, up to November 6th, all the force on the canal that could be made available for that purpose has been occupied in fighting the Cucaracha slide.

We are therefore bound to conclude that a very considerable proportion of the 826,891 cubic yards reported to have been taken from the Culebra cut was taken from the Cucaracha slide and not from the prism of the canal in the Culebra division. Had the attack upon this hill been made by a floating dredge, the slide would in no way have necessitated the interruption of the work for its removal for six weeks or probably two months, while building three railways, which would then have been apparently superfluous.

Nothing that indicates a disposition to exchange the dry for the wet haul has yet transpired in executive quarters.

On the contrary, in the report of Mr. Goethals of October, 1907 (Annual Report of the Isthmian Canal Commission, page 3), we read:

> "As the rock portion of the cut can be *removed* . . . more economically in the dry than in the wet—"

Does not this monumental error show the necessity of completing Colonel Goethals' instruction on this capital point? However valuable may be his services on the canal his time will be infinitely better employed if he is sent to Europe and to Japan to learn what he seems to ignore absolutely, the cheapness of rock extraction by dredging if properly handled, and that it is now *much cheaper* than to remove it in the dry.

As the difference between the wet haul and the dry haul means a difference of at least half in the expense and of more than half in the time required to open the canal for traffic, I will here insert some extracts from the Transactions of the English Institution of Civil Engineers, giving the substance of a recent conference of that body in relation to rock dredging with special reference to the present rock removal operations at Blyth. The substance of their deliberations are embodied in the following extracts from the statements of two of the conferees.

MR. W. H. HUNTER (the Engineer of the Manchester Ship Canal):

"In rock-breaking with rams under ordinary conditions it may be reckoned that about 115 blows could be delivered per hour paid for work. Mr. Quellennec adds that, as a matter of fact, he gets eighty-three blows, so that the difference between the eighty-three and the 115 represents the loss due to stoppages occasioned by passing traffic. We are working, especially in the daytime, under similar conditions; and perhaps it may be interesting if I give the exact figures for the last complete month for which the figures have been tabulated—that is, for the month of April. . . .

"We have at the present time broken with the rock-cutter just under 280,000 cubic yards of rock. Taken all round, the average cost of rock-breaking, which is the point we are really concerned with here, has been 5.9d. You will observe in Mr. Quellennec's figures that there are great differences, owing to the varying character of the rock, but these are actual figures got out by the accountants to the Canal Company. They are actual figures which are furnished to me month by month of the cost of the works which are in hand; and adding that 2d., if you like, it makes the average cost of these nearly 300,000 cubic yards of rock broken by the cutters something under 8d. These are plain matter-of-fact figures."

Mr. P. Bunau-Varilla: "The two very interesting and important notes that have been read in connection with submerged-rock dredging brings out a factor of the highest importance which cannot be emphasized too much. . . . Now we have arrived, thanks to the Löbnitz system, to a point where it can be said that, even against the hardest rocks, the dredging system has every advantage. I wish to point out that from now onward rocks under water can be excavated at a less price than in the open air. It must also be remembered that the last word has not been said with regard to the rock-dredging system, and that new improvements can be expected which will tend to still further lower the price at which the work can be done. The cost of the work, which, as the authors of the notes and the eminent chief engineer of the Manchester Ship Canal have shown, is to-day very low, is bound to be in the future still lower, for the very same reason that makes it now much cheaper than when the Löbnitz system was first introduced. . . .

"We have heard this morning Mr. Hunter stating that on the

Manchester Ship Canal the average cost of making 280,000 cubic yards of rock dredgeable had been 5.9d. We must note the very important circumstance that in three different parts of the earth, in the Suez Canal, at Blyth, and at Manchester, experimental prices are given of the cost of transforming rock into ordinary dredgeable ground ranging from 6d. to 10d. a cubic yard. These are indeed very low prices. You will further notice that in each of those three cases there are hard strata. Mr. Quellennec said that some of the strata are extremely hard; Mr. Sandeman tells us that there is a part of the rock treated at Blyth which can compare in hardness with basalt, and Mr. Hunter also pointed out that there is a very tough and hard rock met with at Manchester. Those three facts show that in the three cases the conditions range from hard to soft rock, and that the Löbnitz system is not to be stopped by any hard rock. . . .

"I wish, as a final remark, to state that however reduced are the prices now obtained, still lower ones are forthcoming; we have not arrived at the end of the development of the Löbnitz system, nor have we arrived at its full efficiency and the lowest price of its operations. We see from Mr. Quellennec's note that rams of three tons, four tons, or five tons could not pierce the hardest ground more than one foot eight inches, and that the cost was 7s. 3½d. With rams of thirteen tons the ground was made dredgeable to a depth of two feet seven and a half inches and the price was reduced to about 1s. Therefore a threefold increase of the ram has produced that extraordinary transformation in the cost and in the productivity of the Löbnitz system. Why should the ram be limited to fifteen tons? There is absolutely no reason whatever. We have seen an extraordinary development of the results by trebling the weight of the rams. I am perfectly sure that if we make another step of the same importance, if we go to rams of thirty tons or forty-five tons, we shall see these already very low prices, ranging from 6d. to 10d., brought down to something absolutely insignificant. For the very hard material in the Suez Canal, which, as Mr. Quellennec says, requires six times more blows than the average rock, the cost will be brought down to what is actually the average. I foresee, therefore, by the simple development of the method which is now passing through one of its progressive stages, the price being brought down to an insignificant amount of 2d. or 3d., and the hardest grounds made dredgeable for about 8d. to 12d. Even with fifteen-ton rams, it is very easy to see that there is no hardness of rock that can resist destruction by the Löbnitz system. When a fifteen-ton Löbnitz ram (thirteen tons in water) presses upon the ground in a statical condition, it exercises pressure which is five times the limit of resistance of the hardest rock (porphyry, two and one half tons per square centimetre), and when it falls from a height of ten feet the accumulated energy on the point, which is one centimetre surface, is just twenty-three times the average energy accumulated per square centimetre of the section of a shell going out of the most powerful gun existing."

VI

MR. BUNAU-VARILLA's suggestion was to provide the first of the locks at the 130-foot level with a bottom at ninety-five feet say, which was sixty-five feet below the average level at which the digging of the bottom of the Culebra cut was left by the French Company. The President, under or with the concurring assent of his engineers, recommended that they should defer providing a single lock until they should reach the eighty-five-foot level for the water and the forty-foot level for the bottom. This means a postponement of any use of the locks for any purpose until the Culebra cut for the whole seven miles had been deepened one hundred and seventy feet below its level as left by the French Company, and fifty-five feet lower than recommended by Mr. Bunau-Varilla. Even should it ever be contemplated to use the locks for the wet haul as proposed by Mr. Bunau-Varilla, this decision defers any use of the canal for transit purposes for the many years to be consumed in digging down the fifty-five feet to the eighty-five-foot level. The object of beginning the lock system at the earlier 130-foot level was not only to expedite the digging of it without waiting longer than was absolutely necessary, but also that the canal might the sooner become navigable and begin to earn its expenses, which would seem to have been perfectly practicable in four years, or by next May.

At present the public has no reliable evidence that the prism of the canal on the Culebra has been deepened a single foot through the whole seven-mile breadth of the Culebra hill, if even at any part of it. The excavations thus far have been mostly, if not entirely devoted to widening the trench already cut by the French Company.

In regard to the locks, Colonel Goethals as late as the eighteenth of August last reports: "In order to lay concrete in locks next year a plant must be contracted for this year, but appropriation not sufficient." He then asks permission to run in debt in excess of the appropriation,—$4,000,000 for labor and $4,000,000 for material, which means of course in part "the plant" for the locks. Thus it will not be until 1909, when at the present rate of monthly expenditure the entire estimated cost of the canal will have been expended, that the real construction of the locks can be expected to begin.

Colonel Goethals in asking permission to run the Secretary of War's face for $8,000,000 says: "This is required, not as an increase of cost of canal but in order *to work faster.*" This despatch will establish the Colonel's hitherto unsuspected reputation as a humorist.

The President promptly sanctioned his engineer's request "to continue expenditures in excess of pro rata monthly allowance *on account of present necessities and unforeseen developments.*"

It will be just like our Congress to be asking a lot of impertinent questions about what were these unforeseen developments. The only unforeseen development at present in evidence is the shameful fact that by the end of the fiscal year in June, six and a half tenths, say two thirds, of the estimated cost of the works ($78,000,000 out of $120,000,000) will have been spent and not one quarter of the work will have been done.

VII

MR. BUNAU-VARILLA recommended to the President a lock canal at the 130-foot level of the Culebra as the most expeditious way by many years of providing a waterway available for commercial or military purposes, but with the understanding that the locks were a temporary provision, to be maintained only until the canal would be converted into a strait.

This plan of a temporary lock canal, contemplating its contemporaneous enlargement into a navigable Strait without interrupting the navigation of the lock canal, was pressed by Mr. Bunau-Varilla upon the attention of President Roosevelt's Consulting Board in September, 1905. He pressed it upon them and the President at that time, and again in 1906.

First. Because, as he explained, the work of the enlargement could go on without interfering in the least with the operation of the lock canal or with its traffic;

Second. Because of the extraordinary and unexpected reduction of the cost of excavation by the employ of natural or gratuitous water power;

Third. Because of the earlier opening of the canal for traffic by beginning the wet haul at the 130-foot level, which he counted upon achieving in four years;

Fourth. Because of the reduced cost of disposing of the *deblais;*

Fifth. Because of the seismic disturbances to which the Isthmus is subject and which by a seam in a single lock or dam might interrupt further traffic on the canal for an indefinite period if not forever. Hence the necessity of making the period of our dependence upon locks as brief as possible;

And, finally,

Sixth. To provide for the inevitable exigencies of commerce for which the lock canal as recommended by the President and now in course of construction will in a very short time prove totally inadequate.

Assuming as true, what authentic statistics already teach us, that there are now ready to take advantage of the canal six millions of tons of freight, what shall become of the tonnage that will be waiting when the American population between the Pacific and the Rocky Mountains, now amounting to only about four millions, shall reach forty millions? What shall become of the traffic when the population of the extreme East, a third of the human race, wakes up from its long sleep? What will become of the traffic when close commercial communications shall be established with the Atlantic coast of America, so rich, productive, and industrious?

Consider the traffic of the Saulte Sainte Marie through which in 1869, less than forty years ago, there passed a little more than half a million of tons. In 1903, barely thirty years later, thirty-five millions of tons were carried, and this, subject to an interruption of the navigation by ice for a third of the year. The traffic for 1905 exceeded forty-four millions of tons. Vessels of war are already building, not only in Europe, but what is more serious, in Japan, which could never be locked through the Isthmian lock canal as now under construction.

So recently as the first of November the following statement appeared in the editorial columns of the "New York Tribune":

> Entirely apart from future developments, therefore, the present demand is for a canal which will give commodious passage to ships of 88 feet beam and 785 feet length. We may well doubt whether the locks as originally planned would do that. A width of 100 feet would leave only six feet at each side of the *Mauretania* or of one of the new battleships which this country is about to build. Theoretically, on the principle that "a miss is as good as a mile" that might be enough. Indeed, a ship 99 feet wide would be quite safe in a lock 100 feet wide, provided she could be kept perfectly true in the centre. But in raising and lowering the ships in the locks it would in practice be exceedingly difficult—without taking entirely too much time in the process—to avoid some oscillation, and the results of even a slight impact of a 25,000-ton steel ship against the walls of a concrete lock are not to be contemplated without much apprehension. The additional ten feet now decided upon will increase the space at each side of the ship to eleven feet. That may be enough, but we doubt if many prudent engineers will consider it an excessive, if even an ample, margin of safety.

VIII

For reasons already cited and others which may become before long of even greater importance, Mr. Bunau-Varilla two years ago urged upon the President as a manifest duty to dismiss from his mind the idea of regarding the lock canal as a perpetuity, but to have it constructed with distinct reference to its contemporaneous enlargement to a waterway *forty-five feet depth at the lowest tides* and *six hundred feet breadth at the surface of the water,* so that the largest ships likely ever to be built may navigate it easily, safely, and as early as possible, and of course dispensing with all locks as speedily as possible,—even with tide locks which would be necessary for a narrow sea-level canal and are no more necessary with the straits which Mr. Bunau-Varilla advised.

It is reasonably certain that the permanent lock level canal now in course of construction, if prosecuted by the present tardy and wasteful processes, will require very nearly if not quite an equal number of years *to begin to earn anything* that the strait would require, and that it will cost more than the strait, and when built will be quite unable to accommodate the steamers of the standard dimensions for ocean navigation at that time, if not of vessels the keels of which are already laid.

A temporary lock canal is indispensable to provide the water necessary:

First. To furnish the light, heat, and power necessary for the whole canal zone;
Second. To float the dredges, the scows, and the tugs;
Third. To dispense with the daily increasing costliness of the whole railway system of excavation at the Culebra;
Fourth. To speed the time by eight years at least, when the canal would become available for traffic.

In his exposition of this subject before the Consulting Board Mr. Bunau-Varilla insisted that the sea-level canal with tidal locks recommended by the majority of the Consulting Board would consume as much money and time as the Strait of Panama would consume by the methods he had proposed for providing water power and its employ in excavation, if adopted. He gives the figures as computed by the Isthmian Commission for the sea-level canal at $300,000,000 and in this allows twenty per cent. for margin and oversights.

In regard to the strait, Mr. Bunau-Varilla estimates the number of cubic yards of excavation at 600,000,000, of which sixteen large electric dredges attacking the central prism would take out 30,000,000 cubic yards a year, or the whole 600,000,000 in twenty years. "This estimate"—as to the time allowed to build the strait —twenty years—during the operation of the lock canal—he says, "is like all that I presented to the Board, the *maximum maximorum* of time and cost. The central prism embraces less than half of the total cube, requiring but 260,000,000 cubic yards of excavation. The other parts of the canal to be enlarged for the strait should be dredged simultaneously with the Culebra, in which case the enlargement and deepening of the lock canal into a strait would require but about ten years."

This prophecy invites here a reference to the official reports of the excavation referred to.

For the three months, January, February, and March succeeding the President's visit to the Isthmus, the monthly output from the Culebra cut averaged 673,000 cubic yards. For April the cube was reported at 879,500. So far it seemed to realize the prediction of the President in December, 1906, when, after referring to the 323,000 cubic yards taken out in September, 1906, he proclaimed that the cubes of excavation were destined to increase in enormous proportions. The next month of May the output fell to 690,363 cubic yards. The War Department had promised that it should pass the million figure. The cube for June fell still lower, to 624,588 cubic yards. For some reason only known presumably in the War Department, this output instead of being announced as early as usual at the beginning of the following month, was not published until the end of July, and was colored by reports through the "Morning Post" of London of friction between the War Department and Colonel Goethals, reported to be much discouraged and anxious to be relieved from further duty on the Isthmus. It is with reluctance that I here report an impression entertained in quarters likely to be informed, that the friction here referred to was that the Chief Engineer at Panama and the War or the Executive Department were not agreed about the ethics of increasing the output by dredging in the prism of the canal, where no place for depositing the excavation had been prepared.

The following month we read of the long-promised million cubic yards of output at last obtained. This time the news did not have to wait till the end of August to be spread over the country that 1,058,776 cubic yards had been excavated the previous month—but accompanied by no intimation that of this output 212,710 cubic yards were taken, not from the Culebra cut but from the canal prism at Colon and at Panama, where the dredging is most easy and subjected to no delay for transportation. So, the dredging in the Culebra cut for July, instead of yielding over a million, was only 770,570 cubic yards. As all the output of the dredges is absolutely required for the dams to be built, why are the dredges doing work that is not pressing and with no place ready to utilize its output?

The August report from Colonel Goethals to the President claims an excavation by steam shovels and dredges of 1,274,404 cubic yards. "This exceeds all previous records," says the Colonel. The President sends him a letter of congratulation for what he terms his "extraordinary showing during the month of August." Unhappily for the credit of both parties, neither alludes to the fact that 358,454 of these cubic yards were not from the Culebra hill at all, but were dug by the Colon dredges and by the Panama dredges,—the dredging of both which ought to have been deferred till the places for which the dredgings were required were prepared to receive them, and the whole force and money expended upon the point of most resistance. Thus the August Culebra output falls back to 786,866.

It is not altogether a strange coincidence therefore that it is in this same month of August that Colonel Goethals telegraphs the President that all the appropriation for the canal provided by Congress for the canal work up to March, 1908, had been expended, and urges him to sanction his "running his face" till Congress meets to confirm such proceeding, that it may not be necessary to reduce the force for want of money. It would be painful, of course, but not surprising if Congress should ask Colonel Goethals to explain at whose behest he operated his dredges in the low Panama and Colon valleys so prematurely, and apparently with no other object than to make a factitious exhibition of the least pressing work to the prejudice of the most pressing. Colonel Goethals has officially recognized that the Culebra cut and the Gatun dam are the great obstacles with which he has to contend, and that the rest of the work would be finished long before these were ready, without taking a single man or machine from those two most immediately important and pressing fields of labor. It will be hard to persuade any person who knows Colonel Goethals that either he or indeed any officer of his rank in the American army would have diverted his men and machines from the work where they are most required merely for such an ignominious purpose as to impose upon Congress or the public.

It would not be very surprising if the real explanation of what our peripatetic Secretary of War authorizes us to call the "cowardice" epidemic, which bereaved his canal department of three chiefs in two years, may have been reluctance to cook the reports of their work to suit the political exigencies of the Administration.

A few words now about the Gatun dam recommended by the President and adopted by the Commission.

This dam was denounced as unsafe, dangerous, and indefensible on scientific grounds by Mr. Bunau-Varilla; it was admitted by the President after visiting it, to be "risky," and his Chief Engineer, who has not yet even begun its construction, says now that the time necessary for the completion of the canal depends, not upon cutting its way through the Culebra hill, but on the construction of this Gatun dam. In this he is doubtless correct. This dam is simply a preposterous piece of work, and should it be prosecuted according to the proposed dimensions, is liable not only to result disastrously to the canal itself and to the whole country below that will be at its mercy, but also to seriously delay the use of the canal.

It is to be erected across the bed of the Chagres River, and to be 7700 feet or a mile and a half long. The water to be supported by the dam will be from eighty-two to eighty-six feet in depth, and 105 feet above the bed of the Chagres. The time for its construction as estimated by the minority of the Board is nine years, but by the majority of the Board fifteen years. The total filling necessary is 20,000,000 cubic yards.

By an almost inconceivable lack of forecast the dams and the locks of the President's plan, both on the Atlantic and Pacific sides, are so located as to be easily bombarded from the high seas.

This is the kind of dam which is to displace the dam at Gamboa proposed by Mr. Bunau-Varilla, which could be built according to his estimate in less than one quarter of the time, at far less than one quarter of the expense, and which would be of dimensions and of mode of construction, as well as of foundations, which no engineer or President would ever speak of as "risky." It is not surprising that Colonel Goethals speaks of the Gatun dam as threatening more delay in its construction than the piercing of the Culebra. His delay in beginning this dam warrants at least the suspicion that he hopes Congress will relieve him from the necessity of prosecuting a work which is so certain to prove fatal to the reputation of the engineer whose name is associated with it.

The strange, not to say obstinate, silence of the Isthmian Commission in regard to methods of construction of the Panama Canal which are commended to them by every consideration of economy, whether of time or expense, as well as by the counsel of one of the most accomplished civil engineers of the age, who has the peculiar advantage of knowing by experience more about the natural obstacles as well as the natural facilities for building the canal than any man living or dead ever knew, seems inexplicable upon any theory which engineers fit to be employed on such a work should be willing to avow.

And how much longer is this scandalously wasteful policy to be tolerated? Shall this Isthmian Commission be permitted to pour the gold of our country as the maiden daughters of Danaus were condemned in Hades to pour water, into a bottomless vessel, eternally?

IX

SINCE writing the above, Mr. Goethals, the Chief Engineer of the canal has repaired to Washington and, under date of December 9, reported to the Secretary of War that the place which the President with the aid of his Consulting Engineers has selected for the construction of three earth dams on the Pacific side were utterly impracticable; and he recommends another site for dam and locks —one lock at Pedro Miguel and two at Miraflores—that is, at the very site recommended since 1887 by Mr. Bunau-Varilla. "It has the advantage over the present project," says Mr. Goethals, "in that the dams of lower height, less length, and resting on rock comparatively near the surface, can be more easily constructed and completed at an earlier date. It is to be preferred by reason of the fact that the location of the locks secures them against all possibility of distant bombardment and affords them greater security against gunboat or torpedo-boat attack."

Obviously the technical, not the military, are the only serious reasons. For surely neither the President nor his military advisors would require two years of reflection to assure themselves that a lock five miles inland is better protected from high seas bombardment than one at the seashore.

Now it so happens that there is not a single one of the advantages of the proposed change of locks and dams that was not just as obvious the day the canal work was visited by Mr. Taft and his Consulting Engineers in April last, nor one that does not apply to the Gatun dam with infinitely greater force; nor one which the location recommended by Mr. Bunau-Varilla for dams on either side of the backbone of the Isthmus would not have avoided.

Notwithstanding Colonel Goethals' recommendation, which the President has approved of, for the abandonment of the Gatun dam, the Secretary of War a few days later—on the 16th instant—informs the Senate Committee on Interoceanic Canals that "it has been decided not to finish the Culebra cut *until the work on the Gatun dam and locks is completed.* Is the War Office myopic that it can see only the Pacific side of the canal but is blind to the Atlantic, or, to use a famous aphorism of Pascal, "True on one side of the Pyrenees, false on the other"?

On the same occasion the Secretary indulged himself with the cheerful prophecy that "the total cost of the canal work" in his opinion "would not exceed $250,000,000, which is only 100,000,000 more than the original estimate of his engineers. The Secretary and his Engineer seem to be yet more discordant as prophets than in their knowledge of the work at the Isthmus, if we may trust the following announcement in the "Sun" of the 19th instant.

CANAL MAY COST $500,000,000

Goethals Says No One Can Tell What the Outlay at Panama Will Be

WASHINGTON, Jan. 9—That the Panama Canal may cost the Government $500,000,000 was the statement of Col. George W. Goethals, chairman of the Isthmian Canal Commission, at a hearing before the Senate Committee on Interoceanic Canals to-day. The admission was brought out in response to questions from the chairman of the committee, Senator Kittredge of South Dakota. Chairman Goethals had said previously that any estimate as to the cost of the canal was guesswork.

"Are you prepared to say that the canal will not cost more than $250,000,000?" inquired Senator Kittredge.

"No, I am not," was the reply. "I believe it will cost all of that."

"Are you prepared to say that it will not cost over $300,000,000?"

"No, as I said before, it is impossible at this time to say just what the cost will be," was the reply of the chairman.

"Would you be willing to say that the cost will not be above $500,000,000?" persisted Senator Kittredge.

"As I said before, it is impossible to say at this time," replied Chairman Goethals. "It might even be $500,000,000."

The "Record" of the eighteenth of December does not give the usual report of the work done in the Culebra cut for reasons which the reader is permitted to conjecture, but we are told that "*good progress was made in the removal of material carried into the* *canal prism by the Cucaracha slide.*" This slide announced its arrival on the fourth of October last by depositing about 500,000 cubic yards of earth upon the railway track and an unknown quantity into the prism of the canal, carrying two steam shovels with them. Three months and a half have already been spent in getting rid of this slide, and on the eighteenth of December the "Record" is hopeful that "within a comparatively short time the slide *will cease to be an inconvenience to the work.*" This statement leaves the reader in doubt whether the Culebra cut is an inch deeper to-day than it was on the fourth day of last October, while the output of the dredges in the lowlands at La Boca and Colon which should have been deferred until the Culebra was cut deeper, boasts of an output in November of 782,720 cubic yards.

Though I have not a word to say in defense of the necessities for or the processes by which so many changes in the consulting and directing engineers whose advice about the construction of the canal has been taken or rejected, I think that the country is to be congratulated upon the fact that an army engineer has been finally selected for the prosecution of this great work, who, as far as the law permits, gives evidence of both the ability and a disposition to prosecute it with a single eye to its speediest and most economical consummation which the law permits. None of the scandalous blunders in the plans or the reckless waste of money which has resulted can be justly laid to Mr. Goethals. His abandonment of one of the two preposterous dams which he was expected to build furnishes the best possible augury that at last the canal work has drifted into the hands of a person who brings a competent professional judgment to his task. It allows us to indulge the hope that after the suppression of the Sosa dam he will make another and equally successful effort to rid us of the Gatun dam. To prosecute on the Atlantic side of the Isthmus something ten times more foolish than what has already been acknowledged and rejected as foolish would surely warrant a writ de lunatico inquirendo to issue to the responsible party.

If now Congress will give Mr. Goethals a free hand, the presumption is that he will next propose, if he has not already done it:

First. Locks at both sides of the Culebra cut, whatever may be its actual level to-day, a series of locks to join with the seas the canal as it is actually opened through the Culebra cut; these locks to be made temporary and economically to pass our battleships and yet more bulky commercial marine monsters while the lock canal is being converted into a strait.

Second. That he will treat the Chagres River as the greatest benefactor and ally of the canal, instead of what it has been hitherto esteemed, its greatest terror and obstruction; will treat it as the beneficent power which is both competent and willing to do all the work of digging the canal except what would devolve upon a comparatively limited number of experts; to supply light by night and by day to prosecute it when necessary, pure and wholesome water in abundance for the whole zone, and a reduction of the payroll from 40,000 men to not exceeding 15,000.

Third. Provide the Bunau-Varilla electrical dredges and Löbnitz rockcutters as fast as required to dredge the prism of the canal by which the rock work can be made as dredgeable as clay and at smaller expense than blasting rock work on land, and by which the dredgings will be disposed of without any railway tracks, trainmen, or any of the obstructions, waste of time and labor that they imply.

Fourth. Finally, ask Congress to carry out the President's effort, ineffectually made two years ago, to transfer the management of the Isthmian Canal from the Secretary of War to the Secretary of State where it properly belongs, and thus relieve both the President and his Secretary of War from duties which in addition to their other cares have proved so much too much for both.

APPENDIX A

WASHINGTON, 26th of September, 1905

Translation from the French.

HIS EXCELLENCY THEODORE ROOSEVELT,
President of the United States,
Washington, D. C.

Mr. President:

I have the honor of remitting to you inclosed the text of the projects which I have submitted to the International Consulting Board on the Panama Canal.

It contains, outside of the mathematical justification of the conception which I had the honor of presenting to you in March last, a new and important chapter on the final development of the method which I propose.

This development insures, by considerations based on technical principles of the strongest and most practical nature, an extraordinary and unexpected reduction of the prices of excavation and at the same time a not less extraordinary, a not less unexpected rapidity of execution, so soon as the first stage will be passed; so soon as the lock canal will be opened with a summit level at one hundred and thirty feet above the oceans, a thing which, as I have demonstrated, is obtainable within four years.

This reduction of the unit prices of excavation, this increase of the efficiency of the works, results from the employment of the natural forces of the Isthmus, thanks to its waterfalls, thanks to the rational utilization of the conditions created by a navigable waterway through the Cordilleras, thanks to the infinitesimal price of transportation of the spoils that will follow the establishment of this waterway. It results also from the creation of an interior sea by the erection of a large dam at Gamboa, which interior sea will receive all the spoils brought on water to it.

If the new method allows the opening to transit in a space of time of which nobody dared to speak, which without it would be chimerical, it also allows to contemplate for the final form of the canal an amplitude of which nobody dared to speak, which without it would be chimerical also.

It is possible with the new factors of price and of time to contemplate not only the establishment of a mere canal at Panama but of a real strait; not only the establishment of a waterway with thirty-five feet depth and two hundred and twenty feet width at the water level; of a waterway closed at its extremity on the Pacific by tidal locks, but the establishment of a waterway of such grandeur that it becomes comparable to those created by nature; of a waterway with forty-five feet depth at the lowest stages of the tide and six hundred feet width at the surface of the water; of a waterway where the greatest ships will be enabled to navigate with freedom without having anything to fear, thanks to this liberty of action from the currents produced by the tides freely admitted in the Straits of Panama, currents the maximum of which on the other hand never will be able to reach three knots and one third.

The opening of the Straits of Panama which necessitates the excavation of six hundred million cubic yards may be easily dug in a maximum space of time of twenty-five years and for a maximum expenditure of three hundred million dollars. In this estimation of time is included the first phase, that of opening a lock canal with a summit level at one hundred and thirty feet when the excavation of a sea level canal with tidal locks, with restricted depth and width, cannot become a reality within this time and for this sum but under great risk, if one employs as it has been exclusively thought up to this day the ordinary methods of work hitherto adopted (excavation in the dry) though such a canal requires but one third of the excavation necessary for the creation of the Strait. . . .

If I have discovered an unknown way through this mysterious labyrinth, if I have reached by a final step the solution of the "Secret of the Isthmus" which holds in suspense humanity since centuries, I owe it to the profound faith which I have in the advantages that will result from it for man; I owe it to the hope, alas, unfulfilled! that my country would find in the work of one of her sons a compensation to the sorrows which this great and generous enterprise has caused her.

It has pleased Destiny to render useless my efforts in that sense, but in its unfathomed wisdom it allows me to believe that these efforts will not be lost for France because they will be useful to America, and that in the grand procreation of the Bosphorus of Panama the two sister republics will rejuvenate their pact of eternal amity while thinking they have served in common this progress, always made of the efforts of the dangers and of the sorrows of man.

In offering to the United States, impersonated in her most eminent son and in the elected chief of her generous race, the benefit of solutions which represent in money more than six hundred million dollars' saving on the works, and the benefit singularly greater still, perhaps, which will result from the immediate delivery of the canal to the activity of its citizens, I am proud of having justified the confidence and the friendship of which you gave me, Mr. President, so touching and so precious testimonies.

I have the honor, Mr. President, of presenting to you my very deep and very respectful devotion.

P. Bunau-Varilla.

APPENDIX B

PARIS, October 29, 1906.

Translation.

HIS EXCELLENCY THEODORE ROOSEVELT,
President of the United States,
Washington.

Mr. President:

I have tried by all means to throw the light of my experience on the way to be followed, and on the fifth of March last I wrote to you, Mr. President, in an open letter:

"I do not hesitate to state that the excavation in the dry, which is necessary (in the plans you have adopted) to reach a level of navigation at eighty-five feet through the central mass, will retard the opening of the canal much more than it is expected; that this question is the only one which presents a real gravity (keeping the date of opening announced), and that, therefore, a higher passage at one hundred and thirty feet is recommended by all considerations of logic and experience."

Here are the grave facts that you are going to verify during your visit, Mr. President:

The discovery of its real causes may save the Panama Canal from most serious dangers. *It may preserve the United States from very cruel dangers, also, to which they are exposed through the prolongated absence of a communication between the oceans in case of war.*

I am trying once more to make the truth conspicuous in order to allow you to grasp it, Mr. President, during your next inspection of the works.

Does the cause of the defeat reside in an insufficient period of preparation or in too great economies?

Evidently no, because more than two years and a half have elapsed since the United States are in possession of the canal and they will have spent at the end of October the considerable sum of thirty-six million dollars.

The expenses at that date surpass by three million dollars the sum of thirty-three million dollars at which were estimated by the United States and paid by them all the works done by the two

Companies of Panama, all the houses, hospitals, storehouses they built, all the installations, and all the plant.

The Isthmian Canal Commission in their reports of sixteenth of November, 1901, and fifth of February, 1906, have stated that the old Panama Company had excavated seventy-two million cubic yards. To this figure must be added seven million cubic yards excavated by the new company.

If you think that the cube excavated at the end of September last by the United States amounts to about three million cubic yards, you will see that to make an excavation slightly superior to three million cubic yards, the United States have already spent a sum substantially superior to what they paid according to their own estimation for an excavation which is compared to theirs in the proportion of one hundred to four.

If one thinks on the other hand of the accusation of disorder and extravagance with which the works of the old Panama Company have been loaded, one cannot help reaching the conclusion that the actual results demonstrate their inanity and revolting injustice.

It is the error of the experts which is the cause of the defeat which the world witnesses to-day.

One has been led to accuse first the soldiers then the officers of the army engaged in this war against Nature.

"Labor is inadequate, we must appeal to the Chinese!" Here was the share of the soldiers.

"The Engineers on the Isthmus are incapable, we must call for the contractors." Here was the share of the officers.

The fault, Mr. President, is not with those who are fighting the battle, it is in the strategy which has been forced upon them.

The actual labor would be superabundant in quantity, no need of Chinese would exist, if the efforts of the workmen were not directed against the natural forces.

The secret of any struggle with Nature consists in associating to your aid the natural forces and not in fighting them.

I have tried before the Consulting Board to make prevail this essential notion that the basic obstacle on the Isthmus was rain under its torrid climate. To execute the works of excavation, of transportation, and of dumping in the dry on rails, it is to be willing to fight against Nature; it is to exact from tens of thousands of men an unfruitful and sterile effort.

To execute the works of excavation by floating dredges and to transport the spoils by water and discharge them into a deep artificial lake made in the center of the Isthmus, is to utilize natural forces and not blindly fight them. . . .

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[1] The figures given for the cube made by the United States differed slightly in the original letter. It was the cube then known by press reports. It has been deemed justified to substitute to these the final figures resulting from official records published since.

By adopting the system of working in the dry, both for digging out the level canal and for digging out the canal with locks with a passage at eighty-five feet above the sea, the Consulting Board committed the gravest of technical heresies.

You see, Mr. President, now the palpable consequences of this error. Under immense difficulties thousands of men fighting against Nature have not been able to do substantially more than three hundred thousand cubic yards, either in July, August, or September.

If, as I proposed, the work of excavation, transport, and dumping by water were installed, three thousand men would easily excavate one hundred thousand cubic yards a day in the Culebra cut. They would do this immense work protected from sun and rain in all seasons. There would then be no need of employing blacks, as white men could work perfectly well under these conditions. . . .

The digging out in the dry of the fifty-three million cubic yards of the Culebra cut is the huge error of the minority of the Consulting Board. The present results show a difficulty which will only increase on getting lower, for the cut will fill still more with rainwater as it gets deeper.

The dredging machine will therefore have to be applied to the excavation. But as the dredging system demands important preparatory works—the execution of a dam at Gamboa and the construction of locks for raising the barges into the lake—while this work is in progress the excavation in the dry may be continued on the highest point of the Culebra.

With an excavation of twelve million cubic yards, a canal can be opened at the elevation of 130 feet, giving passage to an iron-clad. This result may be obtained in four years, even with a monthly excavation of two hundred and fifty thousand cubic yards—an amount of work on which one may rely.

The execution of the locks which are necessary for passage at this level can also be completed within four years.

From that date on, excavations will be continued on the enormous scale that the dredging will permit of, without troubling universal transit.

To this method, which is so simple, the Consulting Board only raised one objection, namely, the imaginary price that it fixed in the most arbitrary way for the cost of the work of breaking the rock in order to render it dredgeable.

Send emissaries to Manchester, Mr. President, or to Liverpool, to Suez, Yokohama, Okasaki, Brest, or to Dakar, and they will see that the rock is crushed and rendered dredgeable at an inconceivably low figure, no matter how hard it may be.

The price of four dollars, seventy-five cents ($4.75), fixed by the first Isthmian Canal Commission for the extraction of the rock under water, and the price of two dollars, fifty cents, fixed by the Consulting Board, are both equally erroneous and misleading.

It is this latter price which was opposed to my proposal. The "Engineering" of August 17, 1906, contains a document given by Mr. Hunter, Chief Engineer of the Manchester Canal, establishing the fact that the average cost, during ten months' work, was less than eighteen cents (ninepence) per cubic yard for the breaking of the rock in the Manchester Canal in order to make it dredgeable. By adding the price of seven and a half cents—which is the official cost at Panama and Colon—for the dredging, transporting, and dumping in deep water, we get about twenty-five cents for the exact price of extraction of rocks harder than the average rock of Culebra.

It is ten times less than the price approved by the Consulting Board (two dollars, fifty), and nearly twenty times less than that approved in 1901 by the first Isthmian Canal Commission ($4.75), moreover the price of twenty-five cents is itself much too high for soft rock of Culebra, as the works at Yokohama and at Okasaki demonstrate more than sufficiently.

A revision should be made, based, not upon preconceived ideas, but on the practical reality of modern methods of execution.

This revision will bring about the suppression of the absurd dam at Gatun, which Godin de Lépinay only proposed in 1879 provided that it was recognized as feasible for his project of a canal lake. . . .

Besides this, the canal as it is now being constructed, seems to be making as difficult as possible the transformation into a strait, which would be so easy if the construction were undertaken with a view to this, as I explained to the Consulting Board.

The minority of the Consulting Board caused the Godin de Lépinay plan to be accepted as the eternal form of the Panama Canal. They appear to have been inspired with the desire to raise an obstacle to any possible transformation. But such a transformation is inevitable. The statistics of the Sault Sainte Marie Canal prove it.

The Senate only voted for the canal on the formal promise of Senator Knox that it would be transformed into this wide, free, sea-level waterway which I have called the Straits of Panama. But the honorable Senator made a mistake, however, in saying that America had half a century before her.

She has only about twenty years before her after the opening, and the transformation must by then, not be merely commenced, but quite finished. Preparation must therefore be made from to-day.

All these serious facts are worthy of the consideration, Mr. President, for which I now respectfully ask.

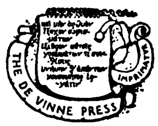
The date of the opening of the canal will be that of the effective protection of the Pacific Coast. Until then it is without any defense, at the mercy of the enemy.

Wrong ideas and bad advice may uselessly delay this date from six to seven, and perhaps even to ten years, and may compromise, both now and later on, the great work that America has undertaken and may perhaps threaten her security in case of foreign war.

The man who declares most plainly the Truth is the one who gives the most substantial proof of his friendship.

It is under the shield of this idea, Mr. President, that I place the expression of the opinions contained in this letter, which I close with the assurance of my most respectful sentiments.

P. BUNAU-VARILLA.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SANTIAGO PÉREZ TRIANA.

LETTER
TO
PRESIDENT TAFT.

An Appeal for International Honesty.

LONDON:
PRINTED BY WERTHEIMER, LEA & CO.,
CLIFTON HOUSE, WORSHIP STREET, E.C.
—
1909.

The unfinished works of the French companies having been acquired

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* Read at the Royal Geographical Society, November 30, 1908. Illustrated by photographs by the author. Map, p. 180.

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45, AVENUE ROAD,
REGENT'S PARK, N.W.,
LONDON, *1st May, 1909.*

To Mr. WILLIAM H. TAFT,
President of the United States of America,
WASHINGTON, D.C.

SIR,

On the 9th day of January of the present year there were signed at Washington, by their respective Plenipotentiaries, certain International Treaties, between the United States of America, the Republic of Colombia, and Panama. In view of Panama's geographical position, which makes it the potential strategic centre in the unavoidable struggle for the supremacy of the Pacific, those Treaties are of world-wide importance; they are intended to bring to a close an anomalous and irritating condition of affairs between the high contracting parties; they are bound to constitute a precedent of far-reaching historic scope in the future relations, not only of the parties thereto, but in all similar international occurrences that may come to pass on the American Continent.

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A

In demanding that the Treaties in each separate case should be ratified by the signatory Powers at home, it was implied, as an essential condition, that the ratification should necessarily and unavoidably, in each and every instance, be carried out in strict conformity with the existing law of each country. Public treaties in the United States, in Colombia, and in Panama, according to their respective Constitutions, in order to be valid and binding upon the nation, must be ratified by the Legislative Body.

The trend and the essence of the Treaties in question redound principally to the benefit of the United States and Panama; they constitute a withdrawal and a settlement of the claims put forth by Colombia against the United States for the secession of its former province, in which Colombia maintains that the United States exercised wrongful action prejudicial to the rights and the legitimate interests of Colombia; they signify, as far as Colombia is concerned, the recognition of Panama as an independent and sovereign nation, and define in a permanent manner the relations between Colombia and Panama on a basis of international equality.

It may be taken for granted that, both in the United States and in Panama, the indispensable ratification by the Legislative Body has been, or will be, forthcoming in strict conformity with the Constitution and the laws of the land. With reference to what may happen in Colombia, it becomes necessary to carefully examine the course of action adopted by the Government, in order to verify whether the ratification will be the right and the lawful one, or whether the danger and the possibility exist that a spurious ratification may be given to the Treaties, which would render them null and void from their inception, engendering the possibilities of disputes and troubles in the future, and entailing moral responsibilities of incalculable potentiality.

President Reyes, of Colombia, on receipt of the Treaties, convened for their approval and ratification a certain body, called the National Assembly.

According to the Colombian Constitution, the duty of ratifying public Treaties concluded by the Executive is exclusively devolved upon the Colombian Congress; which, also according to the Constitution, is composed of a Senate and a House of Representatives. The members of this latter House must be elected by the direct vote of the people, and Congress must meet, of its own right and without requiring to be convened by the President or otherwise, once every two years.

The National Assembly above referred to, is constituted exclusively of individuals personally appointed by President Reyes. When he took office in 1904, President Reyes found Congress in session, and demanded that it should grant to him certain authorities, which were refused. Upon the closing of the Sessions, President Reyes imprisoned and exiled—without trial or any legal formality whatsoever—a good many of the recalcitrant Congressmen, some of whom

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were deported to unhealthy localities, called penal colonies, situated within the borders of the country.

Colombia is politically divided into various sections called Departments; each one of these is provided with a Governor personally appointed by the President, who can also remove him at his own discretion.

The so-called National Assembly was brought into existence in the following manner:—each one of the Governors of the Departments, acting under the President's instructions, selected three individuals, supposed to represent, respectively, the three principal political parties in the country—the Liberals, the Conservatives, and the Nationalists. The individuals thus selected met at Bogotá, the Capital of the Republic, and constituted themselves into what was then called the National Constituent Assembly, which at once proceeded to amend the Constitution, in accordance with the President's express commands and indications. As the amendments were not carried out in compliance with the provisions of the Constitution, they are null and void, and the order of things created by them, under which Colombia has subsisted ever since, is illegal and irregular.

President Reyes has not allowed any popular election to take place since he came into office; no Congress has met, therefore, since 1904. He has eliminated even the faintest shadow of popular representation, replacing the popularly elected bodies by what he calls a National Assembly, which he might have called, had he so desired, by any other name, for instance, National Corps de Ballet, National Acrobatic Troupe, or Colombian Sixtine Chapel Choir.

Those who study the conditions and the trend of events in Latin-America, soon become aware that in various countries of that section of the world, the evolution of political life, during the last few decades, has been steadily towards absolutism, which flourishes and thrives under the label of Republican Institutions. In some parts absolutism has managed to achieve a certain, and, at times, a high degree of material prosperity, of order, and of stability, which, like charity, cover a multitude of sins; in others, its beneficiaries have not succeeded in creating either stability, which, in their case, would mean the permanent usufruct of public power by themselves, nor the material prosperity of the land, which means financial credit at home and abroad. Those of the former category, it may be said, give something in exchange for what they usurp. Material prosperity, in creating large vested interests, may in later years bring about the re-conquest of civil liberty, and the effectiveness of democratic institutions. Such, undoubtedly, should not be the straight and narrow path which the true patriot and lover of his country would voluntarily select for the attainment of the higher national ideals; but in the presence of the inexorable facts, the mind may cling to that hope for lack of aught else. In the cases where the beneficiaries of absolutism give nothing in exchange for what they usurp, when the results obtained are discontent, misery, oppression, and ruin at home, and unavoidable discredit, sooner or later,

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* Read at the Royal Geographical Society, November 30, 1908. Illustrated by photographs by the author. Map, p. 180.

abroad, there is no room for any hope whatsoever; utter darkness besets every point of the horizon, and the citizens of the unhappy nation so situated feel as shipwrecked mariners, cast adrift on a floating log, upon a stormy sea, in the darkest hour of night.

Let it be clearly understood that the conditions above referred to are far from being prevalent in all the countries of Latin-America. In a great many of them, possibly in a majority, the evolution of civil and political life follows a normal course. The daily efforts of the people and of the Government show that the name of Republic, under which they appear to the world, stands for the true essence of their aspirations.

Even in the most oppressed and backward of the Latin-American countries, where despotism is rampant and paramount, the responsibility for the evil condition of affairs rests mainly with those who exercise public power, the people being helpless to defend themselves against their own domestic tyrants, who parade abroad as the elect and the redeemers of the nation.

It is a matter of present day history, which can be easily verified, that in the dark and eventful annals of reaction towards absolutism in Latin-America, no ruler has gone so far, nor so ruthlessly suppressed the liberties and the rights of the people, as President Reyes of Colombia.

It would be out of place here to enumerate grievances that might be considered as begotten or coloured by partisan political spirit; mention should only be made of glaring facts, beyond all possibility of controversy. President Reyes has suppressed all public representative bodies. Instead of a popularly elected Congress, he has created a so-called National Assembly whose members are all personally selected by him. This body votes the public revenues, which the President collects and applies at his own discretion. He has suppressed the most elementary rights of public life, as understood in the light of modern ideas. There is no liberty of speech or of the press; there is no liberty of association. The liberty of trade has been constantly hampered by numerous grinding monopolies, and is always subject to arbitrary interference with the customs tariffs, for the benefit of the initiated, who realise easy gains at the expense of the other traders and of the public at large. The personal liberty of the citizens is at the mercy of the President's will or caprice; men are imprisoned or exiled without trial, and often without even the merciful explanation of the why and the wherefore. *Et sic de cæteris.* . . . .

In referring to the present Colombian Government the painful duty of explaining the preceding facts imposes itself, not with a view to seeking a remedy abroad, but to clearly establish the real condition of affairs. The remedy cannot come, if it ever comes, from outside; nations, like individuals, must work out their own salvation, and sink or float according to their deserts.

The question at issue now, as far as the United States are concerned, is purely and simply one appertaining to

The unfinished works of the French companies having been acquired e lawful and legitimate ratification of the international reaties signed at Washington on the 9th day of January f the present year. President Reyes submitted them to the approval of his so-called National Assembly, which, in the presence of the universal sentiment against the spurious ratification which seemed about to be given, did not ratify them. Even if that assembly were composed of angels instead of men, the ratification that it might give to the Treaties would be null and void, as it is not qualified to exercise such a function.

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As far as is known abroad, on this the 1st day of May, 1909, President Reyes has not succeeded in obtaining the ratification of the treaties; even that Assembly, constituted exclusively of men of his own choosing, has not dared to perform an act of such defiant usurpation and violation of the rights of the people. It is quite within the methods and temper of President Reyes, however, to reconstitute his Assembly with a more carefully selected and more docile set of men, who will not hesitate to ratify the treaties, which, after such a ratification, will be presented to the Government of the United States as legal and binding documents. If such a thing comes to pass, the President of Colombia, and his so-called National Assembly, will be guilty of a great international lie; if the documents are accepted by the United States, knowingly, as would be the case, they will render themselves accomplices and participants in the fraud.

On the 22nd of November, 1822, the plenipotentiaries of Austria, France, Prussia and Russia, signed at Verona, in Italy, a secret Treaty, which was intended to complete the Treaty of the Holy Alliance, signed by the Emperors of Russia and of Austria, and by the King of Prussia, in Paris, on the 20th September, 1815.

Amongst other declarations, the secret Treaty of Verona contains the following :—

> ### ARTICLE 1ST.
>
> The High Contracting Parties, being fully convinced that the system of representative government is as incompatible with the monarchical principle as the maxim of the sovereignty of the people is opposed to the principle of divine right, oblige themselves, in the most solemn manner, to employ all their means and to unite all their efforts for the destruction of the system of representative government in any State in Europe where it may exist, and to prevent its introduction into any States where it may not yet be known.
>
> ### ARTICLE 2ND.
>
> As it cannot be doubted that the freedom of the Press is the most efficacious means employed by the pretended defenders of the rights of the nations, to prejudice the rights of the Princes, the High Contracting Parties promise reciprocally to adopt all the measures necessary to suppress the freedom of the Press, not only in their own States, but also in all the other States of Europe.

As a reply to the spirit of reaction that animated the Holy Alliance, embodied in the Secret Treaty of Verona, President Monroe, in his annual message to Congress in

The unfinished works of the French companies having been acquired

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December, 1823, made, amongst others, the following statements :—

> "The occasion has been judged proper for asserting as a principle, in which the rights and interests of the United States are involved, that the American Continents, by the free and independent condition which they have assumed and maintained, are not to be considered as subjects for future colonisation by any European Power."
>
> . . . .
>
> "We owe it, therefore, to candour, and to the amicable relations existing between the United States and these Powers, to declare that we should consider any attempt on their part to extend their system to any portion of this hemisphere as dangerous to our peace and our safety."

In a broad historic, but none the less precise and definite manner, the Monroe declaration stands for popular and representative government on the American Continent, as proclaimed and maintained in the constitutions and the laws of the Latin-American Republics, which the Holy Alliance was desirous of bringing back under the sway of their former metropolis, wherein, at the same time, the absolutism of Ferdinand VII. was to be re-established by armed force, through the intervention and under the auspices of the Holy Alliance.

The relentless official action of President Reyes in Colombia, which has culminated in the suppression of popular representative government, and of the liberty of the press, embodies the ideals of the Holy Alliance, which he has thus far been able to implant upon the soil of the American Continent.

Sir, on the 19th November, 1863, President Lincoln, standing upon the battle-field of Gettysburg, which was then solemnly dedicated as a burying place for the repose of the remains of those who had yielded up their lives in the defence of the Union, uttered one of the most pregnant speeches that have ever come forth from the lips of man; his words resound through the spaces of time, in the ears of the generations that arrive in turn upon the battle-field of life, with the three-fold authority of the apostle, the redeemer and the martyr, that was his—

> "Fourscore and seven years ago, he said, our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal.
>
> "Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. . . . . . It is rather for us to be here dedicated to the great task remaining before us—that from these honoured dead we take increased devotion to that cause for which they gave the last full measure of devotion—that we here highly resolve that these dead shall not have died in vain—that this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, for the people, shall not perish from the earth."

In that one sentence, "That the Government of the people, by the people, for the people, shall not perish from the earth," President Lincoln crystallised the essence and the doctrine of liberty and of democratic government.

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The United States as a nation are pledged to the maintenance of those principles which have been hallowed by suffering, fortified by constant endeavour, consecrated and sanctified, not only on the memorable occasion of Gettysburg, but on many another, by the blood of men and by the tears of women, along the course of the passing years, over the length and breadth of the land, by the people of the United States.

The duty is thereby imposed upon the people and the Government of the United States never to perform any act which in any manner, or in any way whatever, and much less so if it redounds to their material benefit, shall in any way or anywhere sanction, condone or foster the suppression of the liberty of the people, or the accursed interests of tyranny.

If, in the present instance, the United States of America accept as a legitimate and valid document a spurious ratification of an international Treaty—if in the pride of their power and in their practical omnipotence under the circumstances —if in the eagerness to bring to an end an anomalous and irritating condition of affairs, they should accept the spurious ratification which President Reyes is endeavouring to obtain, —if they do not improve the opportunity for insisting, in an indirect but effectual manner, that the will of the Colombian people shall be consulted—in accordance with the constitution and the laws of Colombia—they shall become a party to the tyranny and oppression under which Colombia is groaning, and they shall throw the whole and overwhelming weight of their moral support in favour of the most irresponsible and most reactionary tyranny that has been seen on the American continent since the days of its discovery. And what is more, Sir, in knowingly accepting a spurious treaty, and in giving it currency as a legitimate document in international life, they would become accomplices to the deed, even as he who circulates, knowingly and for his own benefit, the forged bank notes that have been prepared by another hand.

The United States claim and exercise with increased intensity each day, their hegemony over the American continent. That hegemony should always be for justice and for righteousness; but were it ever to become the instrument of tyranny and of despotism, it would falsify its legitimate ends, and the glorious aims of liberty and justice that through vicissitudes and errors, ever unavoidable in the action of man, have guided the rulers of the Republic since the days of its creation.

If the hegemony of the United States—which, God forbid, should ever come to pass—were ever to spell the abetting and support of oppression and of tyranny, for the material benefit of the United States, then, Sir, it were time that the stars and stripes should be hauled down and the pirates' black flag be nailed to the masthead of the ship of the State.

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All that the United States have to demand, not only as their right, but as their duty, is that the treaties should be submitted to a Congress of popular election, in accordance with the law and the constitution of Colombia. Colombians know that their present Government would do everything in its power, even then, to have a Congress as fraudulently spurious as its National Assembly; but that is a contention of a domestic nature, in which the United States cannot, and should not, have any interference.

Sir, this is the warning and the respectful petition that I bring to your ears in behalf of millions of Colombians. In doing so, I have thought, bearing in mind your exalted position in the world, and my own insignificance, that there is no nation upon earth so powerful that it can afford, without suffering grievous harm, to wed itself to a lie; and no individual so humble that he has not the right to speak the truth to all and sundry, in the full measure of its immortal force, whenever and wherever the conspiracy of events, the cowardice and disloyalty of the weak, the arrogant impatience of the strong, in dire and ominous complicity, threaten the cause of humanity and justice.

I am, Sir,

Your most obedient Servant,

SANTIAGO PÉREZ TRIANA.

THE PANAMA CANAL IN 1908.*

By VAUGHAN CORNISH, D.Sc., F.R.G.S., F.G.S., F.C.S., M.J.S.

(*From 'The Geographical Journal' for February*, 1909.)

HAVING first visited the Canal Works at the beginning of January, 1907, I decided to make a careful study of the undertaking, but the work was interrupted by the earthquake which I experienced at Kingston on the 14th. The investigation of this phenomenon occupied me for the rest of the year, and it was not until 1908 that I was able to resume the study of the Canal Works. For this purpose I visited Washington, and made application through the proper channel to the Department of State, who kindly consented to further the inquiry. I proceeded then from New York to the Isthmus by the R.M.S.P. *Magdalena*, arriving at Colon April 12, 1908. Here Colonel Goethals, chairman of the Isthmian Canal Commission, provided me with a letter to those concerned to furnish all information, and proposed that I should make my way about unattended, and pursue my inquiries independently, which I did. I spent rather more than a fortnight on the Isthmus, daily inspecting the works and interviewing the *personnel*, and I shall always look back on this time as one of the most interesting and delightful in my life. Alike for the student of science and of affairs, there is at present no place more interesting than the Isthmus of Panama.

The locus of the canal is the central line of a strip 10 miles wide, called the Canal Zone, which extends from the Bay of Limon on the Atlantic to the Bay of Panama on the Pacific ocean, and for about 3 miles seawards in both oceans, the group of islands in the Bay of Panama being also included therein.

The occupation and control of the Canal Zone has been acquired by the United States in perpetuity from the State of Panama, a republic, constituted in 1904, whose independence is guaranteed by the United States.

By the Hay-Pauncefote treaty of 1901 between Great Britain and the United States, it is enacted that the proposed canal shall be open on equal terms to the ships of war and commerce of all nations, both in time of peace and in time of war. The canal, however, although in this sense neutral, is national, not international. It is to be operated solely by American citizens, fortifications are to be erected, and its defence will be undertaken by the army and navy of the United States.

The unfinished works of the French companies having been acquired by purchase, and the treaty with the Republic of Panama having been ratified, the Americans started work in June, 1904.

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SANITATION ON THE ISTHMUS.

In July, 1904, Colonel W. C. Gorgas, M.D., took charge of the Department of Sanitation, which he has administered ever since to the great benefit of all concerned.

Natives of the Zone and West Indian negroes are immune from yellow fever, but this swiftly fatal disease has invariably broken out on the Isthmus when a large number of non-immune strangers have gathered there. An outbreak occurred in April, 1905, and soon produced a panic which threatened to bring the whole undertaking to an untimely end.* Heroic measures were adopted; the force of the Sanitation Department was increased to four thousand men; the city of Panama was cleansed and fumigated house by house, the *stegomyia* mosquito which propagates the disease was exterminated, and the epidemic ceased. Finally, the city of Panama was provided with a proper water-supply, was brick-paved, sewered, and plumbed, and there has been no return of the disease. Similar measures have been taken in Colon.

Anopheles, the mosquito of malaria, which breeds on fresh water where grass and algæ grow, is prevalent all across the Isthmus; whereas the yellow-fever mosquito is chiefly confined to the neighbourhood of towns. Protection from malaria is afforded by housing employees in buildings screened by copper gauze, and by oiling or draining stagnant waters. The final method is subsoil draining,† for open channels are liable to be temporarily blocked, forming pools in which water remains stagnant sufficiently long for the larvæ to be deposited and hatched. By these means, and by the supply of quinine, malarial fever has now been so far reduced that it no longer seriously hampers work.

In 1907 the total death-rate among employees from all causes, including accident, was—

	Average number.	Total deaths.	Annual death-rate per thousand.
White employees	10,709	179	16·71
Black "	28,634	953	33·28
Total	39,343	1,132	28·77

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* *Vide* 'I.C.C. Annual Report, 1905,' p. 30; and Colonel Gorgas on "Sanitation in the Canal Zone," *Journ. Am. Med. Assoc.*, July 6, 1907, vol. 49.

† Until the Lincolnshire fens were drained *malaria* was common in that part of England, where it was known by the name of ague.

During the same period, among 1337 American women and children in Commission quarters there occurred nine deaths, an average of 6·73 per thousand.

Modern science, in conjunction with a despotic government, for such in fact is the Canal Commission, has proved equal to the task of tropical sanitation on the Isthmus.

ON THE TYPE OF CANAL.

While the doctors were fighting the battle of sanitation, the Government of the United States was engaged upon the almost equally anxious task of deciding whether the canal was to be tide-level or high level. The Isthmus of Panama is so hilly that, unless by tunnelling, a shipway can only be constructed by following as far as possible the river valleys. That of the Chagres leads from Colon for 26 miles directly towards the Pacific ocean. At or near Bas Obispo the course of the valley abruptly turns, running parallel to the coast. A distance of only about 9 miles separates this place from the low valley of the Rio Grande, which leads directly to the Pacific. This is the route chosen for the canal. But where the upper Chagres meets the line of the proposed canal its surface is 46 feet above tide-level in the dry season, and sometimes 80 feet above during floods. If, therefore, a tide-level canal be made, the waters of the Chagres must either be directed into another channel or controlled in their passage through the canal. In either case the difficulty of the task is much enhanced by the sudden floods to which this considerable river is subject. The same remarks apply to the other rivers on both banks of the canal and on both sides of the divide. The original scheme of De Lesseps would have involved practically three waterways, of which the middle one would have been for navigation, and it would for a great part of its course have been threatened by the higher waters of the artificial river-channels on either side.

The tide-level scheme of the majority-report of the Board of Consulting Engineers appointed by President Roosevelt was different. They recommended a dam at Gamboa to control the upper waters of the Chagres. Their flow through the canal would be so regulated that the currents would not prevent navigation. Other dams and some diversion channels would be made to control the lower waters of the Chagres and other rivers. The Gamboa dam, dealing with the upper waters of the Chagres, was, however, the salient feature of the scheme. It was admitted that the tide-level canal would cost more and take longer to build than a high-level canal, but it was claimed that it would have (in addition to the other advantages entailed by the absence of lift-locks) the great merit of being less liable to damage and obstruction in case of hostilities.

The disadvantage of slow construction was considered, however, to be fatal, and the Administration accepted the view of other experts that the time estimated by the majority of the Board was inadequate for the completion of the tide-level canal, and that the currents would be a source of trouble. Considerations of cost appear to have had less weight than that of delay, but account was also taken of them and they were also against the tide-level scheme.

In 1906, therefore, an Act of Congress was passed sanctioning the 85-foot-level scheme. By the previous "Spooner" Act of 1902, it was enacted that the canal should be such as would provide a passage for the largest ships built or such as might reasonably be expected to be built. Thus the depth of the canal and the dimensions of the locks had necessarily to be much greater than had been contemplated in the high-level scheme which was the later scheme of the French engineers.

The salient feature of the 85-foot-level scheme is the great dam which is to pond back the lower as well as the upper Chagres and all its tributaries in the manner shown on the map. The "Lake Gatun" thus formed will have an area of 164 square miles, *i.e.* twice that of the Lago Maggiore. By means of this dam the streams will be tamed, and a waterway provided which will be broad and easy of navigation for many miles.

Unfortunately, however, the site for the dam, and all other possible sites for such a dam, do not admit of a foundation on hard rock. The Gatun dam is not only to be itself composed of loose material, but is founded partly upon clay and partly upon sand and gravel. The Gamboa dam, on the other hand, would have been founded upon hard rock and could have been built up therefrom in solid masonry, thus forming part and parcel of the stony framework of the globe itself.

THE HIGH-LEVEL CANAL AS IT IS TO BE.

From shore to shore the canal is 41 miles long, but to reach deep water 4 miles must be dredged at either end, so that the whole length is 49 miles; of this about 9 miles has to be excavated in hard rock.

The Spooner Act, the law under which the canal is being constructed, enacts that it shall be "of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draught now in use, and such as may reasonably be expected." Accordingly, the following dimensions have been selected:—

First, a minimum depth of 41 feet.

Secondly, a minimum bottom width of 200 feet in the Culebra cut.

Thirdly, each lock will have a usable length of 1000 feet and a width of 110 feet.

Fourthly, the minimum radius of the curves is 5577 feet (1700 metres).* This curve, however, does not come in the Culebra cut

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* *Vide* p. 205 of Gen. Abbot's 'Problems of the Panama Canal' (1907). Slight changes in the projected course are made from time to time, so that this figure is subject to some modification.

SITE OF GATUN LOCKS AND DAM, LOOKING WEST.

LOCK SITE AT GATUN, LOOKING NORTH.

where the bottom width is to be 200 feet, but north of Bas Opispo where the bottom width is 500 feet. Most of the curves have a radius of 9842 feet (3000 metres).

A reference to the accompanying map will show that most of the curves are situate in Gatun lake, where the width of the canal proper is large, and where the spread of shallower waters secures better steerage.

Thus the high-level canal is not only deep and wide, but also much freer from troublesome curves than might be supposed from a casual inspection of its course. The details of the bottom width of the high-level canal in its different parts are as follows :—

From the Atlantic entrance to Juan Grande (27 miles)	1000 feet.
Juan Grande to Bas Obispo	500 „
Bas Obispo to a point about half-way between Empire and Culebra	300 „
Culebra cut, nearly to Pedro Miguel lock (about 4 miles)	200 „
Pedro Miguel to Pacific entrance	500 „

The length and width of the locks has already been stated. The maximum lift will be 32 feet, or about 4 feet more than in any other locks at present in use. As the width (110 feet) is much greater than that of existing locks, it follows that the lock gates will be far larger than any now in use. A vessel has to pass through a flight of three succeeding locks at Gatun. Parallel with this is a second flight of three locks, so that two ships could be simultaneously put through either flight in the same, or in opposite, directions.

It is hoped to accomplish the whole transit in eight or ten hours. On this basis it is calculated that forty ships could be put through in twenty-four hours from the Atlantic to the Pacific, or two fleets of twenty ships if passing simultaneously in opposite directions.

At Pedro Miguel the vessel passes through one lock on her way down to the Pacific, and at Milaflores through two locks. Each of these three locks has a duplicate alongside, permitting, as at Gatun, the simultaneous passage of a companion vessel, or of one going in the opposite direction.

The lift of the lower lock at Milaflores is variable, depending upon the level of the tidal water in the last reach of the canal. The extreme range of the tide at La Boca, the Pacific entrance to the canal, is 20 feet, that is to say, low water during "spring" tides is 10 feet below the average sea-level. During low tide on the Pacific side, therefore, the water in the canal stands 95, instead of 85, feet above that sea. The sea on the Atlantic side is practically tideless.

Beyond Milaflores locks the vessel enters a reach of the canal which is exposed to the ebb and flow of the tide, and *which will be confined within banks or levees as far as La Boca.* In this respect the plan and the profile are, unfortunately, misleading. The La Boca lock and dam have been abandoned, and no Sosa lake will therefore come into existence, the lowest locks being, as I have said, at Milaflores. I have thought it better to reproduce the existing maps as they stand, rather than to attempt a redraught, which would necessarily be imperfect. The vessel, then, below Milaflores is in a tidal channel, and will be subject to some tidal current. By designing this channel so as to avoid a bottle-neck, and by giving it a width of 500 feet, the calculated current will, however, not exceed 1 foot per second.

It will be seen from the plan that the dredged sea-channel by which the vessel will reach deep water on the Pacific, passes to the west of the Isle of Naos, instead of to the east, as was proposed in the earlier plans. Such will be the navigation of the canal. I proceed to deal with the most important points relating to its locks and dams.

The mitre sill of the top lock at Gatun is 37 feet above mean sea-level, and, if the locks were broken, there would remain 32 feet of water above the dam. Above the Pedro Miguel and Milaflores locks there is not the same surplus depth of water.

Dams have to be constructed in the vicinity of the locks at Pedro Miguel and Milaflores. At both places the dams will be short, and will be founded upon hard rock,* and in each case the head of water to be held up will only be about 40 feet instead of 80, as at Gatun. The construction of the dams at Pedro Miguel and Milaflores is not, therefore, regarded with anxiety.

The great Gatun dam remains the one important experiment in the scheme of the high-level canal, and much attention is being devoted to the planning of this work. The alluvial foundation is a disadvantage shared by the Bohio site formerly chosen, and all other sites in the lower Chagres valley; so that, having decided upon the Panama route and a high-level canal, there appears to be no alternative to the construction of a dam upon this kind of bottom. The details of the proposed structure as elaborated in April, 1908, were as follows:—

The length of the great earthen dam is 7700 feet; its breadth no less than 2060 feet. The weight of the dam per linear foot is more than sixty times the horizontal pressure of the water in the lake, so that the pressure could not move the whole mass; and the weight of the dam is spread over such a great width that it is not thought that the ground will sink beneath it. The form of the section is shown beside the map of the canal zone, and an idea of the topography may be obtained from the photograph on p. 157, which I took in April, 1908. The eastern end of the dam abuts on the hill of hard, fine-grained argillaceous sandstone in which the lock-site is being excavated.

The dam, according to present plans, is not to be merely superposed upon the surface as originally proposed in 1905. Embedded in its earthy mass there is to be a puddled core, and a trench will be excavated to a level of 40 feet below the sea (−40 feet) for the lower part of this core. Nor is this all that is to be done to check seepage beneath the earthen dam. From the bottom of the trench excavated for the puddled core, sheet-piling, made of 4-inch timbers, is to be driven down for another 40 feet, so that sheet-piling and puddled core together will form an impervious barrier to −80 feet; that is to say, 80 feet below the surface-level of the sea, or about 85 feet below the lowest natural surface of the ground. The puddled core is carried up through the earthen dam to the level of +90; that is to say, 5 feet above the level of the lake, which is to be 85 feet above sea. The crest of the dam will be +135 feet, *i.e.* 50 feet above the level of the lake; this excess of height being to provide top weight for increased stability of the whole structure, and also for the purpose of compacting the underlying material. The under-water slopes of the earthy materials have been reduced from 1 : 3 of the 1905 plan, to 1 : 5. On the other hand, it has been decided that the width of 2625 feet given in 1905 was in excess of utility, and that a reduction of between 500 and 600 feet can be made without loss of strength or efficiency.

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* 'Canal Zone Pilot,' pp. 316, 317.

About halfway across the valley occurs a low hill, on which a house is shown in the photograph. This hill is on the crest-line of the dam, and is useful as giving support to the sides of the regulating channel which will be excavated in it. The material of the hill, however, is not the hard argillaceous sandstone of the lock-site, but merely alluvial. The regulating works themselves will be built of concrete, a solid mass built up to +69 feet, and on this piers will be constructed 8 feet in thickness, between which will be the sluice-gates. By their means the level of the lake will be prevented from rising unduly in flood time.

The capability of the dam to maintain the waters of the lake at a sufficient level in the dry season depends upon their not finding a ready way, either through the dam itself or below it. The construction of the dam is believed to guarantee its own practical impermeability. Not only is there a puddled core, but the soil, sand, and rocks of which the principal mass will be composed, will be laid down in the manner best calculated to secure compactness. With regard to underground flow, there is, across most of the valley, a bed of indurated clay which is regarded as sufficiently impervious, and wherever the puddled core and piling are embedded in that clay, it may, I think, be assumed with some confidence that the leakage will be unimportant. On referring to the section showing borings (see map), however, it will be seen that there are in the valley two old river-gorges which, to a depth of 200 and 260 feet, are filled only with gravel, sand; sand, shells, and wood; clayey sand; and so forth. These gorges, measured on the section shown, have widths of about 1200 and 500 feet respectively at the depth to which the sheet-piling goes, and extend about 120 and 180 feet below it. How much water may escape by these gorges it is difficult, indeed, I think, impossible, to say.

ON THE SUPPLY OF WATER AVAILABLE FOR THE NEEDS OF THE HIGH-LEVEL CANAL.

The construction of the Suez canal was a work of excavation pure and simple. The construction of any kind of canal across the Isthmus of Panama involves another task, second only in importance to the primary work of excavation, viz. that of controlling the rivers.

In the case of a sea-level canal the problem would have been, how to get rid of their waters, particularly in the rainy season.

In the actual case of an 85-foot-level canal, the regulation of the rivers, particularly of the Chagres, presents two aspects, viz.—

(1) In the wet season, disposing of the surplus waters.

(2) In the dry season, conserving water supplied by the rains so as to meet the waste caused (*a*) by locking, (*b*) by evaporation, (*c*) by percolation or other underground flow.

The arrangements for taming the Chagres and its tributaries have already been described. They are, briefly, the construction of the Gatun dam and its spillway. But for a high-level canal it is equally important that there should be sufficient water in the dry season.

Probably there is no problem of the Panama canal which has received more prolonged and careful study than this,* and from the data obtained the authorities are confident of an adequate supply. Yet whatever depends upon climate is liable to unexpected accidents, and I regard as an important safeguard the fact that at Alhajuela, on the Chagres, 9 or 10 miles above Obispo, there is an excellent site for a dam which would form a reservoir where some of the surplus water of the wet season could be stored, and supplied to the canal as required. The details for such a dam were elaborated in connection with one of the earlier plans of the canal, so that the necessary data would be immediately available in case its construction should become necessary in the future. This is especially important in view of the possibility of leakage from the Gatun lake.

ON THE PRESENT CONDITION OF THE CULEBRA CUT, AND ON THE METHODS EMPLOYED FOR EXCAVATION AND DISPOSAL OF THE SPOIL.

Reference once more to the plan and profile will show at a glance the length and position of the rocky divide, the whole of which is termed the "Culebra Cut," from the name of the town near the highest point. The proposed form and dimensions of this cut throughout the

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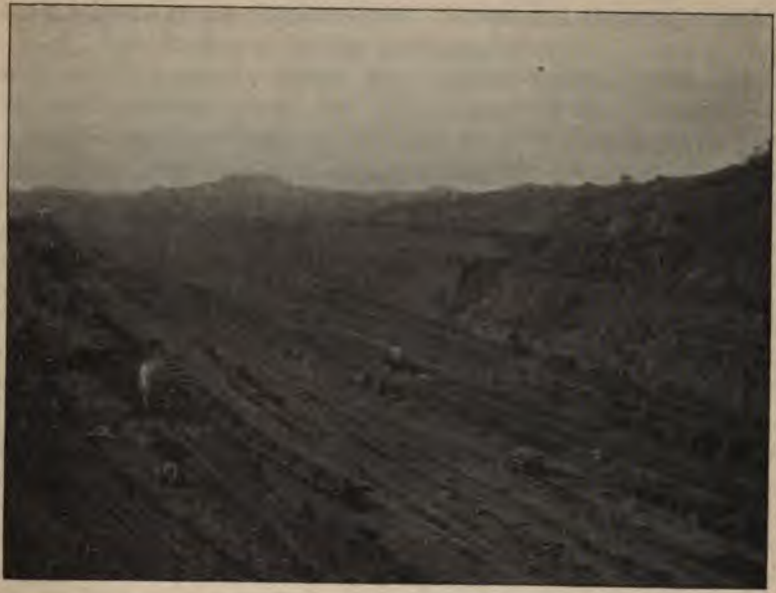
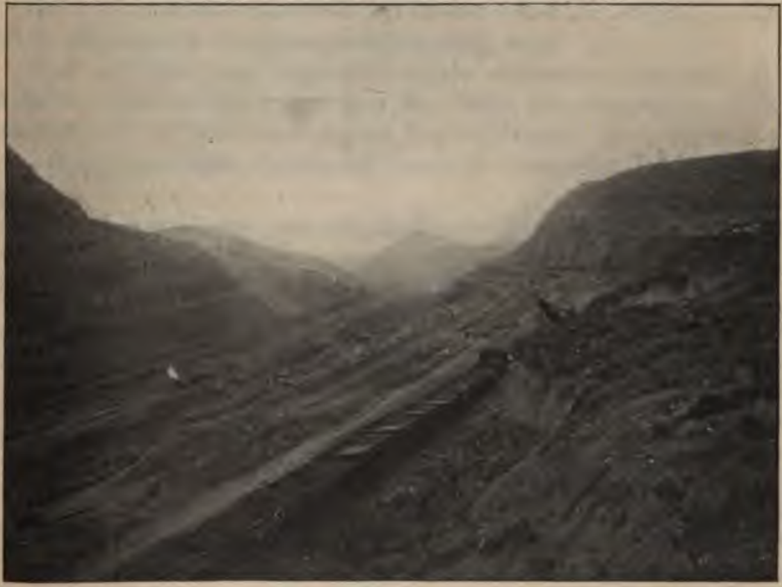
* See 'Problems of the Panama Canal,' by Brigadier-General Henry L. Abbot late Corps of Engineers, U.S.A.



THE CUT AT CULEBRA, LOOKING NORTH-WEST.



THE CUT AT CULEBRA, LOOKING SOUTH-EAST.

5 miles of greatest depth is shown beside the map, this being the cross-section adopted at the commencement of 1906, and the stage reached in April, 1908, is shown by the photographs on p. 163. The line drawn across the above section at a level of 120 feet above bottom (160 feet above sea) shows the general level of the bottom of the workings at Culebra itself at the time when the photographs were taken. A narrow pilot cut, only, was then 20 feet lower. All that part of the section below this line (+160) remained to be excavated. Most of the rock above this line has been removed, but not all, for the final width is not, of course, reached at any level until the central portion has been excavated below that level.

The level of the original rock-line shown in this section was +275, *i.e.* 235 above canal bottom, so that the photographs show excavation of 115 feet of rock. There was, however, soil above the hard basaltic rock, of varying thickness, removed to the slope 1 : 2, as shown on the section. The highest original surface of the soil on the centre line of the canal (between Golden hill and Silver hill at Culebra) was +312 feet, so that the photographs in which Golden hill appears show a total excavation of 152 feet along the centre line. As this line passed along a saddle between the two hills the original surface at the sides was considerably higher, so that the total height from the bottom of the cut to the highest berm, or ledge, on Golden hill is considerably more than 152 feet.

The bottom of the canal will be 272 feet below the original saddle, and its depth below this berm is considerably more.

Thus will the gorge appear when the excavation is finished and before the water is allowed to flow in. When full, the surface of the water will be 227 feet below the original saddle, and the passenger on a vessel will gaze upon the scarped banks of a somewhat greater height than this.

For a tide-level canal not only would the depth be 85 feet greater, but, as the slope could not be made steeper, the width of the whole cutting would be correspondingly increased.

With reference to the slope of the sides it is important to note that it has not been found practicable to adhere always to the proposed section, which has to be made flatter, thus considerably increasing the amount of excavation required. Soil-slides in the wet season are a great hindrance, especially at Cucuracha.

Alighting at Culebra station on the Panama railway and proceeding to the western side of the cut, one obtains the most impressive view of the canal works, and this is the spot usually visited by travellers. I first stood there in January, 1907, and returned in April, 1908. The impressions obtained were very different on these two occasions. In January, 1907, after two-and-half years of American occupation, what struck me most was the enormous mass of material which had been removed by the French companies, and the comparatively insignificant appearance of the American excavations, which could readily be distinguished from the older work already coated with vegetation. It was then that I began to appreciate the heroic labours of the French engineers, whose achievements under circumstances of great difficulty are being daily more and more appreciated and praised by their successors. Turning to study the progress of the work, I watched with delight the operations of the 100-ton steam shovels which, at a distance, when the human hands are not seen, appear endowed with volition. The cars were loaded with surprising celerity and the dirt-train was hauled off to the distant dump by an old Belgian locomotive, part of the machinery taken over from the New Company. But then the hitch came—there were no cars to take the place of those already filled, and the steam-shovel was idle. Looking round I found that many other steam shovels and their crews were idle from the same cause, the machinery for transportation not having been provided in proper proportion to the machinery of excavation. That the time required for the completion of the rock-cut was limited by the possible rate of transportation of spoil, and not by that of excavation, had long been known, and the report of the Board of Consulting Engineers contains elaborate diagrams of space available for shovels and tracks. It was apparent, therefore, that the organization of the work was not yet perfected.

While, however, the fighting force, so to speak, of the Isthmian army was obviously imperfect in many respects, great results had evidently been achieved by the auxiliary services. The Department of Sanitation had already made the Isthmus healthier than most equatorial countries. Food and quarters were excellent; law and order were well maintained.

On the first day of my second and prolonged visit—April, 1908, fifteen months later—I went at once to the same spot on the Culebra cut, opposite to Golden hill, and again surveyed the scene of operations. The change was enormous. The gorge below me was greatly enlarged, the shape of the hills altered, the face of the landscape changed. As I gazed into the deep trench below, the thought flashed across my mind, If my life be spared a few years longer, I will sail through this on a ship.

The reason of the great change was readily apparent. Organization had now been perfected. In the first place, the whole width of the cut was laid down in railway tracks, tier above tier at the different levels, so that the view was like the approach to the metropolitan terminus of one of the world's great railways. Up and down these tracks there came and went without ceasing the spoil-trains, now composed of larger trucks than formerly, with new and ingenious devices for rapid unloading. The number of steam shovels visible was much larger than in 1906; yet they were kept constantly busy, and all the time the drilling machines were at work, boring holes for charges of dynamite, and gangs of men were completing the preparations for explosions in other holes already completed. Yet if the eyes were raised for a moment from the busy scene below, they rested on a silent wilderness of tropical forest, stretching unbroken to the horizon. I stayed until, at the approach of sunset, the work of the shovels ceased, and hundreds of men swarmed out of the cut and sought their quarters and the evening meal. But all was not over for the day, for now, when the cut was cleared, the shot-firing began. At intervals there occurred a deafening explosion; the earth trembled as in a considerable but preternaturally short earthquake, and masses of rock rolled down the slopes, disintegrated, and ready for the shovel-man when he should arrive next morning. I paid many visits to the cut between Empire and Pedro Miguel, but oftenest at Culebra itself. The sight never palls, and is one of the wonders of the world.

During the day the spoil-trains follow one another at intervals of about three minutes, and if, from any cause, delay occur, the steam shovels, and indeed the whole process of excavation, is brought to a standstill. Any cause of delay is therefore reported at once by telephone to the Superintendent of Transportation at Empire, and all energies are at once directed to clearing the way. On the Isthmus everything gives way to the "dirt" train, as it is usually called. It is this dirt which stands between the American nation and the realization of their long-cherished scheme, and nowhere is the classical definition of dirt as "matter in the wrong place" so appropriate as on the Isthmus.

Let us now see how much matter has been removed, and how much dirt remains which has yet to be removed. I will give first the totals of what has been got out in both dry and wet way, both in the canal prism itself and for auxiliary works.

TOTAL EXCAVATION IN CONNECTION WITH THE PANAMA CANAL.*

By the French companies about	81,548,000 cubic yards.
By the American Isthmian Canal Commission up to the end of June, 1908 ...	40,923,533 " "
	122,471,533

Much of the work of the French companies, however, consisted in dredging out sea-level channels at both ends of the canal, whereas the principal American work has been rock excavation in the Culebra cut—or *the* cut as it might equally well be called. The figures relating to the cut are—

EXCAVATION BETWEEN BAS OBISPO AND PEDRO MIGUEL, *i.e.* "THE CULEBRA CUT," 9½ MILES.†

By the French companies	22,600,000 cubic yards.
By the American commission to end of June, 1908	20,125,185 " "
Total excavated in the cut	42,725,185 " "
Remaining to be excavated	37,973,063 " "

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* *Canal Record*, July 8, 1908.

† *Ibid.*, August 12, 1908, and July 8.

so that at the end of last June the cut was half cut through, one quarter having been done by the French companies and one quarter by the American Commission.*

This statement by itself, however, would give an inadequate idea of the rate at which the excavation is now proceeding, for of the total taken out of the canal prism in the cut since 1904, more than one-half was the work of the twelve months prior to June last, and the rate of progress is now even greater than in the year June, 1907—May, 1908.

On the Date of Completion of the Canal.—Colonel Goethals, Chief of the Commission, when examined early in 1908 at Washington, declined to bind himself to a date for completion, or to an estimate of cost; nevertheless it is not difficult to calculate the date of completion from the actual rate of progress on the assumption that all goes well. The year 1915 is thus arrived at by the authorities for the calculated, though not promised, completion. This is based primarily upon the rate of excavation possible under the restrictions imposed by the narrow gorge along which the spoil has to be transported. It has been also calculated that the constructive works, the locks and dams, would require about the same time as, but not longer than, the excavations. This proper balance between the time required for the two elements, excavation and building, was one of the arguments employed in favour of the 85-foot-level canal, as securing "the utmost practicable speed of construction" † which could be obtained in a canal "affording convenient passage for vessels of the largest tonnage."

LABOUR ON THE ISTHMUS.

West Indian Labour.

The success of sanitation, and the modern facilities for storage of food, have greatly simplified the task of obtaining an adequate supply of navvies for the pick and spade work. At first the commission relied almost entirely upon the West Indian negro, who formed the majority of the navvies employed under the French companies. The commission, however, were profoundly dissatisfied with the result, and reported that the negroes seemed to be disqualified from doing satisfactory work by lack of actual vitality.‡

Nevertheless, they are still employed in undiminished numbers on the Isthmus. The lack of strength was found to be due largely to improper diet, and most of the West Indians are now provided with proper cooked meals, as is done in the case of American and European employees. In order to ensure their profiting by this provision, however, the charge for meals in the case of West Indians is deducted from wages. The result of supplying a nourishing diet has been a marked increase in working strength as shown by output.

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* The total excavation for the prism of a sea-level canal was calculated by the Board of Consulting Engineers at 231,026,477 cubic yards.

† See address by President Roosevelt to Board of Consulting Engineers, September 11, 1905, "Report of the Board," p. 12.

‡ "Report," December, 1906.

Although the climate and products of the Isthmus are so similar to those of their own islands, comparatively few of these employees settle there, but return to the homes they love so well. It is gratifying to an Englishman to find that those who come from the British islands are proud of their citizenship and pleased to greet him as a fellow-subject.

The ordinary West Indian labourer receives 10 cents gold (about 5*d.*) per hour and free quarters. Deducting the 30 cents *per diem* charged for meals, he receives 50 cents (2*s.* 1*d.*) for an eight-hour day, besides food and lodging.

The total number actually at work on the Isthmus on certain days has been—

June 30, 1907.	
On the canal works	14,606
On the Panama railroad	4,979
Total	19,585

and on June 30, 1908, the number on the canal works alone was 16,078.

The total number on the roll is of course considerably more than 20,000, as there are necessarily absentees every day owing to sickness, accident, or other cause.

European Labour on the Isthmus.

In 1906, the number of European labourers on the Isthmus was insignificant, and the commission, at the time profoundly dissatisfied with the West Indians, issued invitations for proposals to furnish 2500 Chinese labourers with the privilege of increasing the number to 15,000.[*] Nothing came of this scheme, however, while, on the other hand, the already improved, and still improving, conditions on the Isthmus enabled the commission to obtain a largely increased supply of European labour. While the supply of West Indians was maintained constant, or only slowly increased, the additional force required was therefore obtained from Europe. The following figures show this :—

EUROPEAN LABOURERS ACTUALLY AT WORK ON

June 30, 1906.	June 30, 1907.	June 30, 1908.
500	4317	4913

The majority were from Greece, Italy, and Spain, each of these countries sending at first about the same number. The Greeks were considered to be physically inferior to the Italians and Spaniards, and their number, in April, 1908, was only about 300. The Italians, physically excellent, and standing the climate well, were found somewhat intractable. A large proportion were migrant labourers who had become prone to collective action when dissatisfied, and their numbers in April, 1908, had been reduced to 500 or 600. The Spaniards, mainly Galicians and Castilians, were found to be equal to the Italians in physique and health, and to give far less trouble. The number employed in April, 1908, was about 5000, so that the Spaniards constituted about five-sixths of the European force, which numbered in all slightly over 6000. The figures given above for those at work on certain days are considerably less, there being always a number absent from one cause or another.

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[*] Report of I.C. Commission, 1906, p. 14.

The Spaniards do not appear to be oppressed by working in the tropical heat—even at midday at about the hottest time of year. The ordinary European labourer, in addition to free quarters, receives 20 cents gold per hour, or $1.60 per eight-hour day; more when working overtime. He is charged 40 cents per diem for his three meals, served in the European mess, which leaves $1.20 as a *minimum* net wage per diem, or a little less than 30*s.* per week, but many earn more.

The Spaniard shows no sign of settling upon the Zone. Sometimes he goes on to railway work in Brazil, more often he returns home with his savings.

Skilled Labour on the Isthmus.

The skilled labour on the Isthmus has, from the outset, been mainly done by white Americans, but there are still, on the "Gold Roll," as it is termed, some Europeans. New rules reducing the maximum length of leave have, however, made these posts less attractive to those whose homes are at a greater distance, and by an order of February 8, 1908, all future appointments on the Gold Roll shall be American citizens, if the special services required can be obtained in the United States; and in the event of any reduction of force preference shall be given to American citizens.

An eight-hour day is established by law for employees on the Gold Roll, the quarters are excellent, and excellent meals are provided at a fixed charge in the commission's hotels.

I should like in this place to add a word of tribute to the great courtesy and kindness which the American mechanics show towards ladies, a circumstance which did much to render pleasant the excursions which my wife took on the Isthmus, sometimes in my company and sometimes alone.

In this connection, also, I must add a word upon the marvellous respectability of the Canal Zone, where nothing unseemly meets the eye. Taking all the circumstances into account, this is a state of things of which the American nation has reason to be proud.

The number of Americans on the Gold Roll in January, 1908, was about 6000, the total number of employees on the rolls of the commission and of the Panama railroad being then, approximately, 43,000. The total number of employees actually at work on January 29, 1908, was—

On the canal works, January 29, 1908	25,367
On the Panama railroad	6,557
Total	31,924

The Canal Zone now being healthy, the life of the Americans is a cheerful as well as a busy one. Not only do the men look well, but the women and children also.

The children are able to be in the open air all day, for sunstroke is rare on the Isthmus; they are bronzed and active, and apparently thoroughly satisfied with themselves and with their surroundings. Even when within doors they are still in a sense in the open air, for the windows are unglazed, and the houses are constructed so as to secure a free circulation of air.

The commission clubs for gold-employees at the principal stations are commodious structures, admirably designed for social recreation. Their management is entrusted to the Young Men's Christian Association. There are well-equipped reading and writing rooms and gymnasia, mainly used by the men; but the interests of the women and children are not neglected, and for the latter playrooms are provided. The large halls are used for entertainments and meetings. These clubs and other organizations for recreative pastimes have undoubtedly contributed to improve the general health of the community.

On the Future of the White Race in Tropical Countries.

The question whether the white race can make a home in the tropics depends largely upon the tropical baby; upon his own health, and that of his mother. The American occupation is still recent, but, as far as experience goes, it seems that the white children born on the Isthmus have not shown unusual delicacy, and the mothers have made a normal, though sometimes rather slow, recovery from confinement.

With regard to the possibilities of the tropics for the white race, I submit the following tentative conclusions, viz.—

That the debilitating effect which they have been observed to exercise upon those who come from temperate regions has been due mainly to the presence of certain diseases which can be done away with.

That the rapid deterioration of the white stock which is usually noticed in the tropics, especially near the equator, is largely due to the same cause.

But that Anglo-Saxons cannot perform nearly the same amount of hard bodily labour in a constantly hot climate as they can in the temperate zone, and Anglo-Saxon immigrants never will be able to do so. In this, I think, the Mediterranean races, at all events the Spaniards and Italians, are our superiors.

Whether the descendants of Anglo-Saxon stock who have settled in a tropical country purified from tropical diseases will be able to support continued hard bodily labour better than their immigrant ancestors is a matter about which we have at present little direct evidence.

It is the case that in the tropics, particularly in the equable equatorial belt, many evils of the temperate zone are avoided, chiefly those due to cold and to sudden changes of temperature. It is this equatorial belt of equable temperature and heavy rainfall that I chiefly have in mind, for it comprises those vast regions of prolific vegetation which appear capable of supporting so large a population.

The white man already rules, or has marked off for rule, the whole of the equatorial belt, but who is to be the peasant cultivating this belt? In those parts of tropical Asia already peopled by industrious Orientals there can never be a white peasantry. Equatorial Africa presents great differences in different parts with respect to native population, and the question of a possible future for white peasantry is there a complicated one. In South America, however, there are vast equatorial regions either wholly unpeopled, or sparsely inhabited by tribes of that Indian stock which has elsewhere proved so slight an impediment to the establishment of the white labourer. Served by a system of rivers unrivalled elsewhere in equatorial regions, already partitioned among Christian governments, and for the most part uninhabited, equatorial South America offers the readiest field for the establishment on a vast scale of a white peasantry under the equator.

By clearing the scrub within 100 or 200 yards of his cottage, and by employing wire screens, the cultivator can protect himself against the malarial mosquito, and his crops come not once, but several times, a year.

If the Spanish, Portuguese, and Italian peasant were to turn his attention to this field, instead of, or in addition to, that of navvy work, great things might come of it. The circumstance that South America is a Roman Catholic continent, where the Latin races are dominant, would greatly favour the experiment. On the Zone the Spanish labourer works in order to save and to depart; the *milieu* being foreign to him and unattractive. In a Latin state it would be different.

I put these opinions forward with great diffidence, knowing that they differ somewhat from those of Colonel Gorgas, who thinks * that the future of the white race lies principally in the tropics. The general opinion among Americans on the Isthmus seems to be that, as far as they are concerned, they would, if engaged in the tropical parts of South or Central America, avail themselves of the improving means of transit to revisit frequently the United States, and would rely upon such vacations in higher latitudes for the retention of their native vigour.

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* "Sanitation in the Canal Zone," by Colonel W. C. Gorgas, M.D. *Journ. Am. Med. Assoc.*, July 6, 1907, vol. 49.

ON THE SHORTENING OF DISTANCES.

The sole object of a ship canal is to shorten sea distance. The following figures are actual steaming distances as calculated by the United States Hydrographic Bureau. From New York to Panama, or any port on the Pacific coast of America north thereof, a reduction of 8400 miles. From New York to ports on the American-Pacific coast south of Panama a reduction varying from 8400 to about 1000 miles, on an average about 5000 miles. The corresponding reduction from Liverpool to these coasts is 6000 and about 2600 respectively. The figures for Antwerp are about the same. From New York to Yokohama, *viâ* San Francisco, the reduction is 3729 miles, bringing the Japanese port 1805 miles nearer to New York than to Liverpool. From New York to Shanghai the reduction is 1629 miles, which leaves Liverpool 295 miles nearer to Shanghai.

The Panama canal will not shorten the distance between New York and Hong Kong, Suez being still the shorter route, and even to Manila the reduction *viâ* Panama is only 16 miles; moreover, this small reduction is by way of San Francisco and Yokohama. The all-American route from New York to Manila *viâ* Panama, Honolulu, and Guam is 128 miles longer than that *viâ* Suez. As we go further south in the Pacific, however, the Panama route again is the shorter from New York. Thus the distance to Sydney is shortened by 3806 miles (*viâ* Tahiti), the distance being 2382 less than that between Liverpool and Sydney *viâ* Colombo, Adelaide, and Melbourne. The reduction between New York and Wellington, N.Z., will be 2542 miles, bringing Wellington 2759 miles nearer to New York than to Liverpool.*

The distance between Liverpool and Wellington *viâ* the canal is slightly less than that by the Straits of Magellan. There is also a reduction of distance between Liverpool and the northern parts of the Siberian coast. Otherwise the Panama canal does not shorten distances between European ports and those on the "Oriental" side of the Pacific, the route having been short-circuited by the construction of the Suez canal.

New Orleans and other ports on the Mexican gulf obtain even greater reduction of sea distance to Pacific ports than that obtained by New York; and the important island of Jamaica, with its spacious harbour of Kingston, will be placed in a position of centrality for world commerce which it does not at present enjoy. May the opening of the canal help to restore the fortunes of those who have been afflicted by hurricane and earthquake! That the canal will greatly increase the importance of Jamaica as a member of the British Empire there can be no doubt.

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* *I.e.* Liverpool to Colon, 4720; New York to Colon, 1961; difference 2759 miles, the subsequent routes being the same.

We have seen that the greatest reductions of distance resulting from the canal are those between the two coasts of North America. The sea route, however, remains much longer than that by railway, so that the commercial benefit is (relatively to reduction of distance) less than in the opening up of the Pacific coasts of South America, New Zealand, Japan, and the northern parts of Asia. The approximation of the two coasts will, however, have a profound effect upon the naval position of the United States.

Finally, we must note the peculiar position of that part of the world lying between 40° N. and 40° S., and the meridians of 120° E. and 160° E. of Greenwich. This band, which includes Japan, Korea, Shanghai, the Philippines, New Guinea, and most of Australia, is peculiarly situated with respect to canal routes to the manufacturing countries of the Occident.

Near its western margin the Suez and Panama routes to New York are of equal length. Near its eastern margin, which lies, however, mostly at sea, the Suez and Panama routes to Liverpool are of equal length.

On a line rather west of the centre all places are equidistant from New York and Liverpool, the former *viâ* Panama, the latter *viâ* Suez.

ON THE STEAMSHIPS AVAILABLE FOR CANAL TRANSIT.

The Isthmian Canal Commission in the report of 1899 distinguishes between the commercial and the industrial benefits of the canal, meaning by the former term the increased carrying of goods, and by the latter the development of production induced by improved facilities of carriage.

The tables of distances already given show the *potential* commercial advantages, and how they are distributed in different measure among different countries, and these figures have all the permanence which makes geographical figures of such importance. But the actual commercial advantage of a ship canal depends equally upon a second factor, viz. the available ship tonnage. Supposing a Panama canal to be open at the present time, there would be hardly any United States ships to use it, except in transport between home ports from which ships flying foreign flags are debarred. The transport to South America, New Zealand, Australia, Northern China, and Japan would necessarily be almost wholly carried on by ships of other nations, especially British and German.

In the spring of 1908 there was not one steamship flying the flag of the United States between her ports and those of Brazil, the Argentine, Chile, or Peru.*

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* *Congressional Record*, February 24, 1908.

The three steamships of the Oceanic Line, formerly plying to Australia, were then laid up in the harbour of San Francisco, being unable, although subsidized for mails by the United States Government, to compete with foreign vessels. There were, however, three United States steamers plying from Puget sound to Japan and China, occasionally reaching the Philippines.

The mails from New York and the other Atlantic ports of the United States to Brazil and the Argentine go *viâ* Europe, so that in this important matter New York is actually 3000 miles further than Europe, instead of being 370 miles nearer, to those countries.*

Ships receiving the United States mail subsidy, the only form of subsidy given, have to be American built, manned by Americans, and the diet of the sailors is prescribed by law. Senator Depew † says that, "The labor unions have rightly and properly taken care of their wages. The result is that the cost in wages and food to run American ships under American conditions across the Pacific is double that of European or Japanese steamers."

The relative cost of operating American and European vessels was given by the Hon. Elihu Root, Secretary of State, in an address delivered November 30, 1906, ‡ as follows:—

The operation of an American steamship of 2500 tons costs $18,289 per annum more than that of a British ship of this tonnage, or $7·31 more per ton; and

The operation of an American steamship of 3500 tons costs $15,315 per annum more than that of a German ship of the same size, or $4·37 more per ton.

Thus it is evident that in spite of geographical advantages, there is at present some ground for the extreme opinion sometimes expressed in the United States, that the canal is being built with American money for the use of Europe—and, one may add, of Japan.

What attempts may be made to remedy this state of things, and what effects such attempts may have, are speculative matters which do not come within the scope of this paper.

THE COST OF THE CANAL.

Of the existing canals for ocean-going ships that of Suez was built by a company as a commercial undertaking, to earn dividends from tolls. It cost $90,000,000. The Manchester ship canal is partly commercial, partly industrial, *i.e.* the large contribution of the city of Manchester was made, not as a financial speculation, but in order to promote an undertaking likely to develop the industries of the city. This canal, partly commercial, partly industrial, cost $75,000,000. The Kiel canal has further a military purpose, providing a short line of communication for warships. It cost $40,000,000. The Panama canal is commercial, industrial, and military, and will cost more than all the above put together.

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* Senator Gallinger, *loc. cit.*

† *Loc. cit.*

‡ Address to Mississippi Commercial Congress, Kansas City, revised by Mr. Root, and published *Nat. Geogr. Mag.*, 1907, vol. 18, pp. 61–72.

Up to June 30, 1908, the United States Government have spent $126,047,062 on the Panama canal,* made up as follows :—

Payment to New Panama Canal Company, $40,000,000, and to Republic of Panama, $10,000,000	$50,000,000
Expenditure on work prior to July 1, 1907	43,172,408
Expenditure on work, July 1, 1907—June 30, 1908 ...	32,874,654
	$126,047,062

The amount authorized to be appropriated by the Act of June 28, 1902, was $135,000,000 plus $50,000,000 purchase money = $185,000,000 in all, for the "canal, harbours, and defences." What the total cost will be is unknown, but Colonel Goethals stated in evidence (January, 1908) that the canal would cost at least $250,000,000, and possibly as much as $500,000,000. The combined cost of the Suez, Manchester, and Kiel canals has been $205,000,000.

The following important ship canals have been completed for smaller sums :—

U.S., S.St. Marie (somewhat more than)	$6,000,000
Canadian do. (nearly)	4,000,000
Amsterdam	10,000,000
Corinth (about)	5,000,000
Cronstadt (about)	10,000,000
Welland (Lake Erie–Lake Ontario)	24,000,000
	$59,000,000

Adding these figures to those already given, we have a grand total of $264,000,000 for the cost of nine of the greatest existing ship canals, which is about the same as the lowest current official estimate for the final cost of the Panama canal.

In my study of the Panama canal, of which the present paper is necessarily but a summary account, I have been assisted by many persons, and desire to thank particularly the Department of State at Washington, the Rt. Hon. James Bryce, the Rt. Hon. Lord Avebury, Mr. Claude Mallet, C.M.G., and Colonel G. E. Church. Also Colonel Goethals, chairman of the Isthmian Canal Commission, and his colleagues and assistants, who received me most kindly. Among them I must particularly thank Colonel Gorgas, Major Gaillard, Major Sibert, Major Harding, Mr. Jackson Smith, Mr. Bucklin Bishop, Mr. Arango, Mr. G. R. Shanton, Mr. William Gerig, and Mr. Mason W. Mitchell. I also profited by the learning of Mr. Tracy Robinson, an historian of Isthmian affairs.

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* *Canal Record*, August 12, 1908.

I left the society of the men who are making the canal with great regret. I cherish the hope that I may revisit them, that I may see their task crowned with success, and that I may yet gaze from the deck of an ocean liner upon the terraced sides of Culebra cut.

Before the paper, the PRESIDENT: No words are needed on my part to introduce to you Dr. Vaughan Cornish, who has given us so many papers before, and whose lectures we have so often enjoyed. He has generally for his study taken the study of waves, but to-night he deals with a different class of problems. He is going to discuss the Panama canal, and discuss it from every possible point of view which can in any way be considered geographical. As you have come to listen to the lecture and not to me, I will, without more ado, ask Dr. Cornish to kindly deliver his lecture.

After the paper, Colonel G. E. CHURCH: We have listened with keen interest to the lecturer. He thoroughly understands that any one describing the work being carried out at Panama should be extremely careful of his statements. I do not share in the idea that the white man can compete with other races in occupying tropical lands. There are, of course, in America immense areas of these, notably in the Amazon valley, mostly malaria infested; but I do not believe that the mosquito is entirely to blame for the malaria. I have in mind at this moment a work which is being carried out in the Amazon valley, an old enterprise of mine, the Madeira and Mamoré railway, situated exactly in the same latitude south of the equator as Panama is to the north. There are now 1500 men employed on that work, and measures of sanitation have not been taken similar to those of Panama, although every provision has been made for the health of the men. I have recently had information from there that the negro, while he does not fall ill with malaria so quickly as the white man, recuperates from it with less rapidity. It is a curious fact that there are no mosquitoes but plenty of malaria along the line of the falls of the Madeira. I have no doubt that the white man could occupy the whole Amazon valley if he had the United States Treasury behind him to give sanitation like that of Panama. Unfortunately, the emigrant to new countries is generally very poor, and is unable to carry with him many tons of petroleum, and organize brigades of men to fight mosquitoes. These lands cannot be occupied by white men in competition with negroes and other races of tropical breed. I have been struck with the marvellous feats of administrative ability performed at Panama by the French and Americans, and yield humble tribute to the engineering talent of France and to that of the corps of engineers of the United States army, that they should have planned and carried out so admirably such magnificent works as are now proceeding there. But I also submit that they have not yet tackled the great problems incident to the cutting of the canal; these are still to come, and we must withhold our judgment until we see them well under way. It is now twenty-seven years since work was commenced by the French, and it is *an astounding fact that the definitive plans for the canal have not yet been decided upon.* Meanwhile, millions sterling have been poured into that Danaïdes sieve simply to "*make the dirt fly.*"

But what is the Panama canal being cut for? Is it for commercial purposes? or strategical reasons? or for a better control of the Pacific ocean? Look for a moment at its commercial position. Ninety-four per cent. of the population of the world lies to the north of Panama, and of the other 6 per cent., the traffic that it will give the canal is not very great. If the United States Government is so anxious for commercial development, why has it so neglected the eastern side of South America? There are to-day 3000 European steamships yearly entering and clearing at the ports of Buenos Aires and Rio de Janeiro, and not one of them carries the American flag. The Argentine Republic alone is doing to-day, with its 6,000,000 of population, a larger export and import trade than the entire 400,000,000 of the Empire of China.

It may sound rather strange to you, but South America does more export and import trade than the Indian Empire of Great Britain. But where does that trade come from? It comes almost entirely from the eastern side of the Andes, within as easy reach of New York as it is to the ports of Europe; and yet, as I say, you look in vain for the American flag there. But they tell us, and I have seen many articles written in American magazines and newspapers about it, that wonderful results are to take place on the Pacific coast when the canal is opened, and that this west coast trade will go largely to compensate for cutting it. Only 6 per cent. of the area of South America lies on the Pacific slope of the Andes, and the twenty-eight passes of the Andes lying between 7° 45′ and 23° S. lat. average above 15,000 feet elevation, the lowest being 10,000 feet. Surely it is not proposed to cross those passes with railways, to take the trade of eastern South America across the Cordillera.

Is the purpose of the canal to give us more brotherly relationship with the eight millions of Philippine *Objects* we purchased of Spain? (I call them *Objects* for the simple reason that we have no *Subjects* in the United States.) But Manila, the capital of the Philippines, is exactly as near New York by way of Suez as it is by way of Panama. Is it worth cutting a Panama canal to save the 16 miles difference that Dr. Vaughan Cornish told us of? There is another point, any voyage between the ports of Europe and Asia is shorter for ships by way of the Suez canal than it is *viâ* Panama; therefore you may eliminate at once the entire inter-trade of Asia, Africa, and Europe from the influence of the canal. Again, suppose the canal were opened to-day, and with a toll, say, of 4*s.* per ton, which I suppose would be the minimum, can it compete with the Pacific railways across the continent? Is it possible that a man sending goods to the eastern part of the United States will ship them say, from 100 miles inland in California to the Pacific coast, put them on to a steamer, carry them through the canal round to New York or Philadelphia, and then transport them by rail to the interior, or will he at once put them on to a Pacific railway? What would be the cost of freight *viâ* Panama, including canal toll, between New York and say San Francisco or Vancouver? Surely not less than 30*s.* a ton, if we measure by freights as they are now or have been for the last two or three years; and yet, Mr. President, the Canadian-Pacific railway to-day has a regular freight tariff of 30*s.* a ton between Montreal and Vancouver. Do you suppose when the canal is completed that the railway rates cannot be lowered? I assure you the Pacific railways look as if they might very readily beat the canal on the freight question, for not only will they carry goods more expeditiously, but for less cost of insurance. Able men have played with statistics in a very curious way; they figure that the canal will commence with a traffic of anywhere from five to seven millions of tons. How do they get these figures? By taking all the entrances and clearances of ships at ports possibly tributary to the canal. But this is a very crude method. The Pacific coast of South America or North America is an example, because there it is that the canal hopes for its largest traffic. Take the little Costa Rica port of Punta Arenas on the Pacific, which shows about 320,000 tons a year of commerce on the basis indicated; the actual fact is that it does about 12,000 tons of trade a year. Take the west coast of South America, there are regular lines of English and Chilean steamships that go up and down the coast, touching every day at two or three ports, dropping and picking up a few tons of cargo, and every port touched is given credit for entrances and clearances of from 5000 to 10,000 tons, according to the registered tonnage of the steamer. Thus the French Panama Company, as well as the United States Commissioners, have always made their figures. I may say that, with a year of labour, I analyzed all the commerce that would possibly go through the canal if it were open to-day, and I could not make it a million tons; so I will leave the commercial aspect of the canal for those mathematicians who see millions of tons in one steamship every year.

Finally, has the Panama canal a strategical aspect? Yes, it is strategical. In all time, I believe, nations have fought tremendous wars to turn the trade of the world across their territory. My country is the only one that seeks to "side-track" the grand trade avenues created by the private capital and resourceful energies of its own people. There is a mountain wall known as the Rocky mountains and the Andes, extending from the Arctic sea to the Straits of Magellan which seems to bar off Europe from any contact with the Pacific by a western, route except by the way of Cape Horn. It gives the United States a magnificent controlling position; and I do not see why we want to abandon it by opening a gateway through the centre of it. I come to the naval aspect of the canal, but with much diffidence, for I see some very able naval experts here to-night. I believe that it will take just as many ships to defend the Panama canal in case of war as it would to defend the Pacific coast without the canal, and that the interest on the cost of the canal (say, on at least £100,000,000 sterling) would keep many battleships in commission.

Mr. BERNACCHI: About eighteen months before Dr. Cornish's second visit I found myself compelled to spend seven days on the Isthmus of Panama—seven of the most dismal and uncomfortable days I ever spent, and when I say uncomfortable, I do not at all express what I felt. But notwithstanding the climate, hotels, and other things in general, the Isthmus is of deep interest to the scientific traveller. What impressed me was the fact that although so much time and thought had been devoted to the organization of the various departments, the educational question had not been forgotten. The year of my visit witnessed the establishment of English free schools in the various municipalities.

Three of the chief obstacles at that time appeared to me to be, first, the nature of the country itself; second, the flood waters of the Chagres river and the construction of those immense artificial dams; third, the scarcity of labour. The last difficulty has, we are told, been overcome, but I still believe that the Panama canal, should it ever be completed, will be built in the main by Jamaica labour, by the Jamaica negro.

Mr. MACKINDER: I listened with very great interest to the criticisms of Colonel Church, and with a great deal of what he said I agree. But I submit that whether you regard the matter from a geographical or a financial point of view, he wrote off the strategical side of the question rather too lightly. Even if you take the cost of the canal as one hundred millions, that would only build forty capital ships nowadays, and Great Britain has already more than forty such ships in commission. If the United States mean to have one of the first-rate fleets, the cost of that fleet would be more than equivalent to that of the Panama canal, and such a fleet has to be rebuilt every fifteen years. Therefore I submit that since two oceans are concerned, the cost of the canal might prove to be a very valuable investment. The part of the United States which lies west of the hundredth meridian west has a very small rainfall except along the border adjacent to Canada, and in California. The vast majority therefore of the American population must, probably for all time, live on the Atlantic slope. But the United States is deeply interested in Oriental markets, and she carries a great deal of traffic across the continent, therefore she is interested both in the Pacific and in the Pacific terminals of her railways. Her chief base of power must, however, be on the Atlantic coast. Her motives are thus those which induced Germany to make the Kiel canal. I submit that the construction of the Panama canal is not a bad investment for the United States, given the intention of being a naval power on both oceans.

Mr. **Theodore Walker**, who had been to Panama last spring, remarked that the tide on the Pacific side is, as far as he could judge, 14 to 20 feet higher than on the Atlantic side, where it was, he believed, only about a few inches. In that case, he thought it would have been very difficult to have made a canal on the level from sea to sea.

The **President**: Time is getting on, and I think I had better bring this discussion to a close by giving a very hearty vote of thanks to the lecturer, Dr. Vaughan Cornish. We have had an extremely interesting discussion, and I should like before he replies to ask one question, with regard to the effect of opening the canal. I cannot help believing it would have been possible to make some sort of rough estimate of the saving to the world at large in the shortening of distances, and therefore, from this point of view, of the capital value of the canal. I should like to know from Dr. Cornish what in his opinion is the best estimate, from the purely commercial point of view, of what the canal will save to the world. No doubt the French would have been wise if they had made such an estimate before commencing this work. The Americans, also, might have been wise to do so, but I do not think it would have stopped them either. They have what I may call a sentimental reason for their actions—a feeling that this great work has been commenced and ought to be finished at all hazards. I also think that the strategical value of the work to the United States will be very great indeed. The canal is to be opened to ships of war in time of war, and if one considers the advantages of being able to transfer ships from the Pacific to the Atlantic when such a power is denied to their opponents, any one must see that the canal will be worth a great deal to the United States.

Dr. **Cornish**: The advantages which it is hoped to obtain for the United States by the construction of the canal are of three kinds, viz., commercial, industrial, and military; and the event which determined the building of the canal was a military one. This was the voyage of the battleship *Oregon* in 1898, at the commencement of the war with Spain. This vessel, one of the few battleships which the United States then possessed, was in the Pacific, and had to steam round South America to effect a junction with the remainder of the fleet. For weeks the whole nation was kept in a state of nervous tension until the news of her arrival at Key West. This experience created a general feeling throughout the country that an Isthmian canal was necessary—a feeling which provided the Administration with the necessary motive power. Whether this instinctive strategy be right or wrong is a matter upon which experts differ. The shorter line of communication increases the power of offence, but entails responsibilities of defence. Whether the advantage or the disadvantage is likely to be the greater is a question, the answer to which depends largely upon another question, viz. Which nation or nations are likely antagonists? That is a question which it would be difficult to discuss non-politically, as our rules require. On account of the mixed motives for the construction of canal, I have not examined very carefully the direct financial return, for I do not think the undertaking can be properly regarded as a business concern.

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